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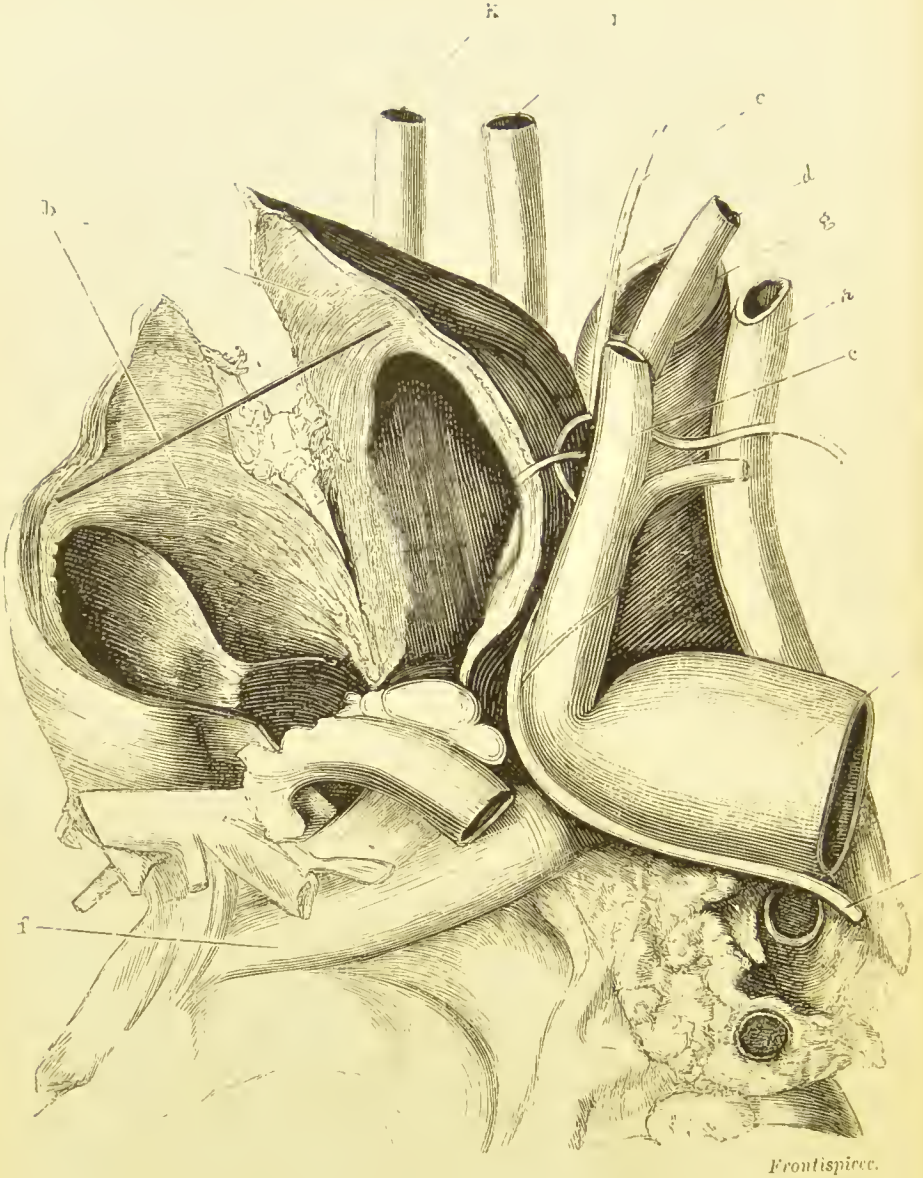

Frontispiece.

a.—Aorta.
b.—Aneurism nearly filled.
c.—Left subclavian artery.
d.—Left jugular vein.
e.—Left vagus nerve.
f.—Left innominate vein.
g.—Trachea.
h.—Œsophagus.
i.—Right carotid artery.
k.—Right jugular vein.

ON ANEURISM:

ESPECIALLY OF

THE THORAX AND ROOT OF THE NECK.

BY

RICHARD BARWELL, F.R.C.S.,

Surgeon to Charing Cross Hospital.

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PREFACE.

To my colleagues, the Physicians of Charing Cross Hospital, are due my warmest thanks for very many opportunities of studying and treating cases of aneurism admitted under their care, whereby I have gained an experience, which renders unnecessary any apology for this little book. I beg also to thank the Council of the Medico-Chirurgical Society for permitting me to use the engravings, which have from time to time illustrated my papers in the Society's Transactions.

My gratitude is especially due to Dr. Pearson Irvine for his kind and valuable assistance in looking over and correcting the proofs.

RICHARD BARWELL.

32, George Street,
Hanover Square.

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ON ANEURISM.

CHAPTER I.

THE FLAT LIGATURE.

THE introduction of asepticism modifies very considerably the death-rate, or, in other words, the dangers of surgical operations; hence must in many cases render such procedure far more life-saving than what is euphuistically called the "expectant" method; nor do I think that any department of surgery is so profoundly affected by this recent development as the treatment and management of aneurism.

Let us consider the position of a patient, who had suffered deligation of the carotid artery under the former system, and whose wound has done well under the circumstances,—that is to say, it has all healed by first intention except the little sinus-like track, which permits a silken ligature tied round the vessel to pass through the skin to the outward air

or dressings. This cord, running along an elongated funnel, was during the operation more or less soaked in blood, and for thirty-six hours afterwards was saturated in wound-secretion, and soon after that was sopped in pus. All these fluids must, since atmospheric impurities have free access to them, become putrid—at first near the surface and then more and more in the depths; so that the artery is ultimately wrapped round by a putrescent material. Moreover, the noose of the ligature destroyed for a certain distance above and below it the vitality of the vessel; the dead portion was sloughed away, *i.e.* separated from both living ends by ulceration. Since the patient lay on the back, the pus, rendered putrescent by the foul ligature enclosing a piece of dead flesh, must gravitate to the bottom of the wound, into the sheath, and lie in close proximity to the vein. A mechanical arrangement more adapted for the production of blood poisoning would be difficult to conceive.

Case I.—This is not a picture evolved from my inner consciousness. In 1847 I was dresser to Mr. Joseph Henry Green, and on the 16th December of that year he tied for aneurism the carotid artery of a woman otherwise healthy, and who was under my superintendence. On the 28th the pus was observed to be of a brown colour; three days afterwards pain and stiffness about the wound and course of the vessel came on. The suppuration had been abundant since

the 3rd; on the 7th she complained of pain in the left knee. The ligature came away on the 13th January, *i.e.* twenty-four days after the operation (I had been directed on no account to make any traction upon it). From the 3rd January till the 22nd February, when she died, various abcesses formed and were opened.

Post Mortem.—There was in the neighbourhood of the wound a dissecting abcess, with which the divided ends of the artery communicated by open orifices.

The artery remained open below the seat of ligature to within half an inch of its origin, where it was sealed by a plug of coagulum. Above, the vessel was likewise patent as far as the bifurcation, where it was closed by the coagulum, which filled the contracted aneurismal sac. The portion of artery below the ligature contained pus mixed with what appeared to be broken-down blood-clot, while the part above the ligature was empty. The vein was closed at a point even with the aneurism by a thin plug of a bright golden-coloured lymph, while it was plugged below by coagulum. The inner membrane of the vessel was covered by lymph of various colours, in different stages of decomposition; and between the two plugs of coagulum it was filled with thick pus. On the inner and posterior part of the vein, on a level with the ligature of the artery, was an oval opening communicating with the abcess. This abcess extended downwards between the muscles to the pleura, in

the parietal portion of which was an ulcerated opening about the size of a shilling, whose edges were adherent to the pulmonary pleura at the apex of the right lung.

Chest.—Heart and great vessels healthy. No appearance of general pleuritis. In the upper lobe of the right lung were numerous little deposits of pus, about the size of millet-seed, which might be called miliary vomicæ (pyæmic deposits).

Head.—The ventricles of the brain contained perhaps a little more serum than in health. No difference could be found in the size of the two carotids; in fact, all else was healthy.

Abdomen.—In the abdomen the only observable abnormal appearance was a fatty and somewhat enlarged liver.

Leg.—On cutting into the thigh and leg a very large quantity of dark-coloured and very fetid pus escaped in a jet. This came from a diffuse abcess, which had separated, infiltrated, and partly destroyed all the muscles of the thigh and upper part of the leg. This abcess also communicated with the knee-joint, where the cartilages were all swollen and soft, and in many places eaten away, particularly at the posterior surface of the patella, which was nearly bare.

[1] An almost precisely similar condition caused death in deligation of the femoral artery, performed in 1860 by Mr. Canton, and also, according to various statistical tables, of many others—but, of course, it is not intended to assert that such mishaps were frequent; the risk was, however, always present.

Other arteries are almost equally, or even more, exposed to like dangers. The femoral, the external and common iliac all lie deep and in close proximity to, the subclavian at the second and third part of its course at a distance from the companion vein. All unprotected wounds, partly in and partly out of which a thread is lying, must be exposed to putrefactive changes; the immediate vicinity of a large vein accelerates but does not produce the peril. Nevertheless I must not be supposed to say that all or even the greater number of cases, thus operated, die of pyæmia; I only say that this is one of the dangers, and that it is by no means inconsiderable.

The risks thus described are eliminated by asepticism, and especially by the use of a ligature which, being soluble in the tissues of the body, does not therefore require to come away; but permits the immediate closure of the wound. Catgut was first employed with this intention by Sir Astley Cooper; but although his first case was successful—*i.e.* the wound healed and nothing more was heard of the ligature—subsequent experience was very unfavourable, and the material was abandoned until Mr. Lister showed that by steeping it a while in carbolic oil with a small proportion of water it could be made to dissolve, or, as he said, to become organized in the tissues.

As far then as danger from pyæmia and the sloughing of certain lengths of the artery go, a large

step had thus been gained, but not the largest nor probably the most important, viz., the risk of secondary hemorrhage at the place of deligation.

Here I may be excused for entering with some detail into matters, which concern the past. The operation of tying arteries for aneurism was, previous to the time of John Hunter, so frequently fatal, that it was hardly practised save by very bold, I had almost said reckless surgeons. This extreme measure of danger appeared to that most eminent man to arise from the fact that vessels were tied very near to the aneurism, where their coats were in a state of disease. The result of his labours was the introduction of the "Hunterian operation," that is, deligation of the vessel at some considerable distance above the sac, branches being given off between the tumor and the ligature. In Hunter's first experiments broad, tape-like ligatures were used, and secondary hemorrhage was the invariable result. In 1805 Dr. Jones published his now classical work on hemorrhage and the use of the ligature,[1] and the theories there inculcated have remained, until my papers were read at the Medico-Chirurgical Society, unchallenged. The views to which I more particularly refer are those concerning the proper use of the ligature for the attainment of safety.

[1] *A Treatise on the Process employed by Nature in suppressing Hemorrhage from Divided and Punctured Arteries, and on the Use of the Ligature, &c.* By F. D. Jones, M.D. London, 1805.

Dr. Jones considers it necessary "to cut through the internal and middle coats of the artery, and to bring the wounded surfaces into perfect apposition."[1]

But as soon as a ligature was introduced, which underwent solution in, which need not therefore be afterwards extracted from the tissues, this doctrine appeared to me to require revision. The altered circumstances rendered it, in my idea, an error still to insist upon the effusion of coagulable lymph, and on the necessity of an internal arterial wound to induce coagulation of the blood, as even so lately as April, 1879, one of my critics in the *Lancet* still maintained[2] because a great number of aneurisms cured by pressure clearly showed that mere arrest of the circulation by simple occlusion of the vessel is sufficient to produce coagulation in the sac of an aneurism, and in a sufficient length of the artery, to insure the clot against subsequent dissolution. Impressed with this idea, I made a number of experiments to discover what amount of tension might be used without dividing the two inner coats; I learnt with my hands to recognise this amount, and attribute the success of my first cases to having kept the traction below what would cut through those parts of the vessel. But herein, naturally, lies a considerable difficulty, and subsequent study of catgut convinced me that it is an unreliable material for tying arteries in continuity.

[1] *Loc. cit.* p. 163. [2] *Lancet*, 1879, vol. i. p. 782.

Very frequently when a fresh bottle of carbolized catgut is opened it emits, in spite of the disinfectant, a strong putrescent odour. Often, too, in tying vessels, as on the face of a stump, piece after piece will break, even with very slight traction. These, however, are inconveniences unworthy of mention, did they not help to explain a feeling of distrust in the reliability of the material, which is supported by a sufficient array of cases.[1] Thus, when the vessel has been tied, we cannot with certainty predict what the piece of catgut on the artery will do, for different samples, nay! even different parts of the same cord, may act differently. Sometimes the material is dissolved so rapidly that pulsation and the aneurism return in from thirty-six to forty hours; sometimes it will not dissolve at all, sometimes it seems to divide all the coats very quickly; occasionally it pierces a hole in them or in the neighbouring vein. This unreliability I was at first inclined to attribute to variations in the mode of carbolizing; but certain conditions showing that herein was error, led me to inquire into the process of the first manufacture of catgut—of the raw material which the instrument-makers convert by carbolization into antiseptic ligatures.

[1] Mr. Macarthy, Mr. G. G. Heath, of Newcastle, *Lancet*, vol. i. 1877; Mr. Bryant's cases, *Clin. Soc. Trans.* vol. xl. p. 1; Mr. T. Smith's case, *Clin. Soc. Trans.* vol. xi. p. 32; Mr. Christopher Heath's case, *Clin. Soc. Trans.* vol. xi. p. 52.

The following is the method as described in Chambers' *Cyclopædia*:—

"Catgut is generally prepared from the intestines of the sheep, rarely from those of the horse, ass, or mule, and *not* from the cat. The first stage in the operation is the thorough cleansing of the intestines from adherent, feculent and fatty matter, after which they are steeped in water for several days so as to loosen the external membrane, which can then be removed by scraping with a blunt knife. The material which is thus scraped off is employed for the cords of battle-doors and rackets, also as threads in sewing the ends of intestines together. The scraped intestines are then again steeped in water and scraped, when the large intestines are cut and placed in tubs with salt to preserve them for the sausage-maker; and the smaller intestines are steeped in water, thereafter treated with a dilute solution of alkali (4 oz. of potash, 4 oz. carbonate of potash, and 3 to 4 gallons of water, with occasionally a little alum), and are lastly drawn through a perforated brass thimble, and assorted into their respective sizes. In order to destroy any adherent animal matter which would lead to putrefaction, and the consequent development of offensive odours, it is customary to subject the catgut to the fumes of burning sulphur—sulphurous acid—which acts as an antiseptic and arrests decomposition."

It will be seen that putrefaction sufficient to allow

the scraping away of the "external membrane" (probably the peritoneum and outer layer of the muscular coat) must have set in after the first steeping; the two subsequent exposures in, I believe, the same water must carry the decomposing process pretty far, previous to disinfecting the intestine with sulphur fumes.

Herein, it appears to me, lie the causes of the variable nature of catgut ligatures, since previous to fumigation certain lengths, or portions of lengths, must be very putrid, others less so; hence the fragility of certain parts, the evil odour of freshly-opened bottles, the too rapid solubility, as also the occasional tendency to promote ulceration.

But even this condition, highly undesirable as it is, appeared to be less objectionable than the shape of the material, since, as above stated, it is very difficult to tie a round cord about an artery tight enough to stop the blood-current with certainty, and as certainly to avoid division of the inner coats. But this latter point was with me the great desideratum, because in the deligation of certain vessels the method so strongly inculcated by Dr. Jones entirely fails to procure safety from secondary hemorrhage. The vessels in question happen to be those whose safe deligation was my especial object—namely, the large primary branches at the root of the neck.

Mr. Erichsen gives (*Science and Art of Surgery*, vol. ii. pp. 109, 113) fourteen cases of deligation of the first part of the subclavian, and a like number of the innominate artery. Every one of these patients, who survived long enough to test the mode of deligation, died of secondary hemorrhage, save one in the latter category, who was saved by tying the vertebral (Smyth of New Orleans). This one case out of twenty-eight was saved, four died from the immediate shock of the operation, twenty-three bled to death from the place of deligation. Evidently if the most important aneurisms of the body are to be treated surgically at all, revision of Dr. Jones's teaching under circumstances so greatly altered becomes a necessity.

The only form of ligature, as far as my experiments go, which can be relied on not to divide arterial coats, that is to say, which can be tied firmly round an artery and yet will leave it uninjured and hemorrhage-proof, is a flat or tape-like band. Such a ligature must not dissolve too quickly, must not excite inflammation, and must bear a secure and reliable knot. There is no necessity for details concerning the many substances, which underwent trial at my hands, until the idea occurred to me that the best material wherewith to surround an artery must be arterial tissue. I procured from my butcher [1]

[1] There was here a little difficulty—the man whose duty it is to divide the carcase runs his knife along the vessel (pipe he

the aorta of oxen in a perfectly fresh condition, placed them in a three-per-cent. solution of carbolic acid, and began my experiments. I found that this material appears, when introduced, let us say, between the skin and muscles, to be organized to become a part of the animal body; the details of experiment cannot, however, under existing circumstances, be published. To make out of the vessel a ligature, it is only necessary to peel away the outer cellular coat, and then with a pair of scissors skilfully to cut the middle and inner coats spirally round and round, taking care to keep the breadth equable. The long ribbon as thus obtained is, however, far too elastic to be securely tied; the knot rapidly loosens itself. The redundant elasticity is to be eliminated by suspending the cord and hanging to it a weight of from two to four pounds, according to its thickness.

Thus treated, the ribbon dries in about six hours into a horny or vellum-like substance; any previously neglected irregularities may be scraped off with a sharp pen-knife, then the cord may be stored in antiseptic gauze until wanted. About fifteen or twenty minutes before the operator is ready to pass the needle, a sufficient piece of the material is to be soaked in a three-per-cent. solution of

calls it), thus splitting it, and letting it lie flat along the spine to serve as a guide for his axe. Most carcases are cut up out of London.

carbolic acid, when it will become quite soft and easy to tie.[1]

Now this ribbon ligature does not divide the arterial coats, but leaves the vessel entire, secure therefore, from secondary hemorrhage, probably even when such arteries as the innominate or first part of the subclavian are tied. By its use no excuse or occasion for secondary hemorrhage is given. This statement does not rest on theory only. Seven human arteries only, as far as I know, have been subjected to the treatment, but those have been among the largest in the body, viz. :—

Two carotids.

Two subclavians (third part).

One external iliac (probably) or common.

Two femorals.

In none of them has the ligature been since seen or heard of; it has given no trouble; all the cases have done perfectly well.[2]

From the operation of tying large and deep

[1] While in the dry state the substance must not be bent sharply, lest some of the fibres break and weaken the cord. In view of such possibility a sufficiently long piece should be soaked and tested when wet to make sure of sufficient strength.

[2] The iliac artery was ligatured by Mr. Holmes after compression had been used for seven consecutive hours, and when the man's limb was already gangrenous. The artery had to be tied very close to the sac—with any other ligature dangerously close. The whole course of the aneurism after deligation was of the most favourable description, but of course gangrene continued. The man recovered.

arteries the dangers have thus been eliminated. A careful and thorough application of antisepticism renders pyæmia, to say the least, very rare. Non-division of any of the arterial coats gives no opportunity for secondary hemorrhage. Judging from the experience I have as yet acquired, very few operations, probably no major operation of surgery, will bear a smaller mortality than the deligation, after this method, of even the largest arteries. This being premised, we will in the next few chapters consider how to utilise the new power bestowed.

CHAPTER II.

ANEURISM ABOUT THE LIMBS.

ANEURISM about the limbs, up to within a very recent date almost the only ones in which surgery took any interest, may be subjected to different modes of treatment. Rest, diet, various forms of pressure, flexion, &c., have all been successful in some instances, have all failed in others; we generally hear a great deal of the former, and very little of the latter class of results. Just at present, however, we are not interested in these methods further than to observe that the last two are somewhat uncertain, are painful and often prolonged; that far from rendering subsequent procedure more safe, as was taught twenty years ago, by enlarging communicating branches, this very circumstance, save in very old and feeble persons, adds an element of uncertainty to the result; since a too free collateral circulation has in some cases caused early return of pulsation, retarding or even preventing cure; while as in a lamentable case at the beginning of this year, possible

injury to the artery by bruising of its coats, forms a very real and positive danger. Having cured cases of popliteal aneurism both by ligature and compression, having also once or twice failed with the latter expedient, having seen the amount of pain, anxiety and restlessness, which treatment by pressure often produces, I should say decidedly that if *jucundé* "pleasantly" is to be still considered a desideratum of treatment, the ligature far exceeds in value any other mode. I have heard patients, who have undergone both means, say afterwards, that had they known the difference between the one method and the other, nothing would have induced them to undergo pressure.

CASE II.—As an instance, let me relate the following history of a gentleman, aged thirty-eight, whom I, in conjunction with Mr. Cadge and Dr. Beverley of Norwich, cured of a popliteal aneurism by instrumental proximal pressure, in the middle of May, 1870.

The patient, although he had suffered an attack of acute rheumatism twenty years previously, was healthy, the aneurism being the result of a strain. He was most courageous and patient: the pressure—I being only able to see him occasionally—was, by the kind co-operation of the above-named gentlemen, most carefully and delicately regulated. Chloral, during the week of treatment, was twice administered; the first time with good effect, the second with

such unpleasant results that he declined to take it again. The following is his own account of the treatment, which began on Sunday, May 14, 1870:—

"The change of pressure from the groin to the thigh, and *vice versâ*, took place night and day, and I slept very little; but was so absorbed in the determination to aid treatment by lying still and bearing all the pain I could, that the sleeplessness did not trouble me very much. I think forty-six minutes was at first the average of time during which I could bear the pressure unchanged; afterwards twenty or twenty-five minutes was as much as could be endured without alteration. I do not think there was any special difference either in this or in the pain and throbbing at any particular point of the twenty-four hours. The skin was well taken care of, and bore the pressure wonderfully. Day after day, night after night went on, and my surgeons could report no certain or reliable progress. I became much disheartened. On Friday, from eleven to four, I suffered most; the place of pressure had to be constantly changed. My energy began to forsake me; I had not slept at all since the chloral-nightmare of Wednesday evening, and felt that I could not go on much longer. The vessel seemed to throb more violently and faster, the screws to jump with each pulsation more and more; I really felt both dispirited and exhausted, when, oddly enough, the artery suddenly gave up the fight—

ceased to throb. I could bear the screws three-quarters of an hour at least with ease; and fell into a quiet though not a long sleep.

"The screws were, however, retained. On the following day Mr. Barwell saw me; relaxed for that night the pressure very considerably; and after a consultation on the following morning removed the machinery altogether; exactly a week after treatment was first begun."

To this I may add, that pain and numbness of the limb, more especially provoked by exercise, lasted for three months. Even a year and a half afterwards the patient wrote: "Walking at three and a half or four miles an hour will soon bring me to a standstill."

This history, of certainly a successful result, is detailed in the Clinical Society's Transactions, 1872; and at the previous meeting Mr. Cooper Forster related the case of a gentleman with whom I was acquainted, and for whom he had cured a popliteal aneurism by complete occlusion with digital pressure. This patient suffered very considerable pain six years after treatment. Such sequel also follows very generally the cure by the Esmarsch bandage.

As far as I know, this sort of pain, which is produced by pressure upon nerves, does not result from ligature; numbness from lack of circulation must, of course, for a certain period persist,

especially when exercise calls for a large blood-supply, but the trouble is very transitory.

We will now take three cases cured by deligation, in two of which pressure had previously failed.

Case III.—John R., aged 45, was admitted on 30th Oct. 1879, into Albert Edward Ward, Charing Cross Hospital, under the care of Mr. Bellamy, with a popliteal aneurism, which was about the size of a bantam's egg. The man had syphilis three years before, and after that a severe attack of acute rheumatism. The aneurism was rapidly getting larger, and the sac was very thin. On Nov. 4th, 5th, 6th, and 7th, pressure with the Esmarsch bandage was tried for thirty minutes in every four hours. There was no benefit whatever, but the man complained bitterly of the pain.

On the 10th Mr. Bellamy tied the superficial femoral artery with a flat ligature.

27*th*.—The tumor consolidated very rapidly although the man was very restless. He was greatly annoyed that he had been put to considerable pain by the pressure, saying that he might have been cured at once without any trouble or pain. He was discharged at the above date at his own request.

The next case illustrates, besides failure of pressure and after-success of ligature, that even diseased arteries may be ligatured safely, if only the two inner coats be left entire.

CASE IV.—Owen M., aged forty-nine, was admitted under the care of Dr. Green, 30th October, 1877, with symptoms of several diseases. He had been a soldier in the Crimea, India in the Mutiny, and other places; was several times wounded, and much exposed; had drank freely, had marks of syphilis, some albuminuria, the physical signs of early phthisis, and a prolonged blowing diastolic murmur, best heard in the middle line of the sternum between the second costal cartilages.

There was marked pulsation of the vessels at the root of the neck. At the lower part of the left axillary artery was a fusiform aneurism about two and a-half inches long, and a smaller dilatation of the brachial. The vessels of both arms and fore-arms were large, tortuous and rigid. A long and large fusiform aneurism occupied the whole length of the popliteal space. The arteries, superficial enough to be felt, were all rough with atheroma. On November 9th the man was transferred to my care.

15*th November.*—Yesterday I tried compression by Esmarsch's bandage, keeping it on for thirty minutes with no effect; again to-day it was tried for seventy minutes, but uselessly.

16*th.*—Digital pressure was tried for half an hour, but the man refused to submit longer.

22*nd.*—The aneurism, increasing in length, is also much larger in circumference and appears on the point of bursting. The man speaks of pressure with horror

and will not submit to it; but begs earnestly, warned of the great risks in deligation of so diseased a vessel, that the artery may be tied. I acceded to his request, and found the superficial femoral closely studded with blotches of atheroma. I had previously softened, by soaking in a solution of carbolic acid, a piece of catgut, which I now partially untwisted and tied round the vessel as loosely as possible; that is, making only enough traction to stop the pulsation in the aneurism.

26*th.*—Wound healed. No pain nor temperature.

10*th December.*—Patient has had no drawback; his other symptoms improved, cough better, gained flesh and strength. Discharged to sea-side Convalescent Home.

It is difficult to trace any connection between the operation and the undoubted improvement in the pulmonary and renal symptoms which followed. The man had been on the same regimen and diet for several weeks previously without such amelioration.

Case V.—Henry B., aged 29, was admitted into Albert Edward Ward under my care, 20th January, 1880, with a very large popliteal aneurism.

The man, a cavalry soldier for nine years, had been discharged in 1875; since then had worked as a bricklayer, had to bend his knee a great deal, was not aware of any injury or strain. Contracted in 1871 a hard chancre—there were some

slight tertiary symptoms, cracks at the side of the tongue, and some copper-coloured marks on left thigh; seems never to have had any other manifestations. Has had rheumatism rather severely (subacute).

Seven weeks previous to his admission he had on getting out of bed a sharp pain at the back of the right knee, when on feeling it he found a lump about the size of a hazel-nut. This tumor increased rapidly, and caused a great deal of pain at the place, running up the thigh, down the leg, and principally at the inner side of the foot. Sometimes the tumor jerked very violently (probably muscular from nerve irritation). On admission he was pale, unable to stand; knee semiflexed. A pulsating tumor, measuring five inches from side to side, lay in the upper part of the popliteal space, and extended along the inner side fully a fourth up the back of the thigh. When looking at the limb from the front, one could see the pulsation on each side of the knee. The swelling was pyriform, the base downward, apex upward; it emptied readily on compressing the femoral above, and filled very rapidly when pressure was removed. The sac was very thin and lay near the skin.

The man suffered a good deal of pain, which was sometimes starting, sometimes severe aching, running along the bone; this was relieved by medicines. The form of the tumor, the thinness of the walls, the

evident absence of any clot about them, and my faith in the new ligature, caused me to discard all attempts at pressure.

29*th*.—Tied the superficial femoral with flat ligature antiseptically.

19*th February*.—The first night after the operation he had some, but less, pain; there was no loss of temperature in the limb. Wound was healed but not skinned over on the 10th; quite well on the 16th; consolidation of the aneurism and some diminution took place at once, and during the week just passed the tumor has been rapidly shrinking. On the above date, three weeks after operation, he was allowed to get up.

6*th March*.—Was discharged, walking without crutches or stick. He had not had a bad symptom. The pain ceased almost entirely after the first twenty-four hours of operation.

In quoting these cases, as in the words which precede their narration, it is far from my purpose to deny advantages to the treatment by compression; I should on the contrary advise it in all cases in which success appeared probable. But if deligation by my ligature be as safe as it seems likely to prove, such treatment is in many ways preferable. I myself, were I the subject of aneurism, would certainly choose to avoid the pain, discomfort, and uncertainty of pressure; there can be no doubt as to which is the least unpleasant.

Nevertheless the pleasant cannot alone fix our choice of treatment, and many cases occur in which indirect pressure, instrumental, digital, or by the Esmarsch bandage, should be fairly tried. More especially should one of the first methods be employed in subjects whose arteries are diseased and rigid, as also in those of considerable age and of enfeebled constitution; since careful intermittent pressure, even if it do not cure the aneurism, may in all probability produce a certain enlargement of collateral branches, which will in so far mitigate the risk of gangrene. This risk, which has not been previously mentioned, is in operations on the upper extremity too slight to be taken into account. After deligation of the main artery supplying the lower limb, the possibility of gangrene is, on the contrary, not to be overlooked. The tendency thereto is commensurate with two circumstances—with the healthiness of the patient and of his vessels, and with the place at which the artery is tied. Exclude the first factor as so variable that it can only be considered in direct reference to each case, and we conclude that deligation of the superficial femoral at the apex of Scarpa's triangle can rarely be productive of gangrene (venous complications being excluded). At the groin, *i.e.* above the deep femoral branch, such event is far more likely, while ligature of the common iliac must of necessity have considerable tendency to destroy the vitality

of the limb below.[1] It seems to me that occlusion of the vein by inflammatory or pyæmic clot has been one cause of gangrene. Yet we must not consider that this complication is connected with deligation only, for it sometimes follows persistent attempts at cure by pressure, even though the aneurism may not have received any benefit, as in the case of ilio-femoral aneurism treated by Mr. Holmes. Sometimes even it is the direct result of the aneurism itself, no local treatment having been employed. Gangrene is of course a result of rupture of the sac if the limb be not amputated; but may also arise, the sac still remaining entire, from pressure by the tumor on the vein.

[1] I am not concerned here to quote statistics of operations performed in bygone days. As already stated, I consider the aseptic method and ligature to have so profoundly modified the practice and results of operations for aneurism, that these numbers are only interesting in an historical point of view. Mr. Poland, Norris of Philadelphia, Stephen Smith, Mr. Hutchinson and others, have given excellent statistics. The reader curious on this point will find these well collated and commentated in the *New System of Surgery*, vol. iii. p. 605.

CHAPTER III.

HIGH CAROTID ANEURISM.

High carotid aneurism, by which term I mean an aneurism arising from that part of the common trunk which lies above the omo-hyoid, is in certain respects more analogous to aneurisms of the limbs than of the root of the neck. It most commonly arises near the bifurcation, but may spring from any part of the vessel. The surgeon should be aware that a certain normal increase in the size of the artery, just at its division, is, especially in women, not very unusual, and that this expansion may, as age advances, become more conspicuous, either from the loss of subcutaneous fat, frequent in elderly females, or from real enlargement, which may not, however, pass the limits dividing disease from mere peculiarity of form. Hence a pulsating tumor at this part of the female neck should not be at once diagnosed, still less treated as aneurismal, more especially if it have been discovered through accident by touch or sight, or have been merely observed by some third person,

the patient experiencing no painful or obstructive symptoms. The rule in such a case is carefully to watch the tumor, to measure by compasses or other means from day to day, or week by week, its condition. If it be stationary and no pressure symptoms arise, surgical interference is unnecessary, or may at least be postponed.

CASE VI.—I was consulted in Nov. 1878 by Mrs. G, aged 62, on account of a pulsating tumor on the right side of the neck, which gave her no inconvenience, and had first been observed by her husband. There was no history of injury, and the lady was in perfect health, but of late had grown considerably thinner. There was very visible pulsation on a level with the thyroid cartilage; at each systole the tumor looked nearly the size of a pigeon's egg; the pulsation, which was markedly expansile, ceased on compressing the carotid below. To the touch, a rather considerable dilatation of the artery was evident, but not so great as appeared to sight; some of the expansion being certainly venous, probably from pressure of the dilated part of the artery on the jugular vein. I carefully measured the limits of expansile pulsation, and watched the case closely during a fortnight, and in that time found no change whatever. Relaxing my vigilance, I saw her then only from time to time. In February, 1879, I happened to meet at her house her younger sister, who told me that previous to her marriage, which

happened just before she was twenty, my patient had been very thin, and she (the sister), with others, had often noticed a great beating on the right side of her neck, and that the spot looked then, as far as she could remember, exactly the same as it did at the time of speaking. After marriage, and till lately, the lady had grown considerably stouter, and it is likely that the increased *embonpoint* overlaid and concealed the pulsation.

While avoiding unnecessary interference, we are to remember that, if the tumor be increasing, no time should be uselessly lost; the growth is in this situation usually rapid; nor is there very much room to spare. Such aneurisms tend as a very general rule upward, yet, combined with growth in that direction, a certain downward extension may also occur; if in growing the tumor come to cover the trunk of the artery, the difficulties and dangers of treatment are enormously increased.

Aneurisms at this place may be subjected to indirect (proximal) pressure, and even to direct pressure, and to the ligature. There is no doubt that proximal pressure, alone or combined with direct, has cured a certain number of cases; its application, by no means easy to the surgeon, is very painful to the patient; as from the latter cause frequent intermissions are necessary, success can only attend prolonged treatment. Digital pressure by a commensurately large staff of assistants is better and

more bearable than instrumental; the place where the least amount of force exercises the greatest influence is Chassaignac's tubercle, as the transverse process of the fifth cervical vertebra is named. Generally, pressure on any part of the vessel produces after a time *vertigo*, *tinnitus auris*, faintness and sense of sickness. This is generally attributed to disturbance of cerebral circulation, but I believe wrongfully, since I have tied a considerable number of carotids without producing any such symptoms. It would seem to me that interference by compression with the sympathetic, and perhaps also with the pneumogastric nerve, is more likely to be the cause of the unpleasant sensations. After a certain number of sittings the parts become accustomed to the manipulation, and the uncomfortable effects are somewhat mitigated. Pressure, direct or indirect, has chiefly been successful, and the cases are not many, in traumatic aneurism—as in Mr. Humphrey's, Signor Ciniselli's, and d'Allier's cases—and should the patient desire such treatment, his wishes may certainly be given full weight, especially if the tumor be of slow growth; but this must during such attempt be very rigorously watched, nor must the aneurism be allowed to increase to such extent as would preclude or imperil the more efficacious measure by deligation.

After tying the common carotid below an aneurism situated near the bifurcation, pulsation of

the tumor may be only diminished, or, if entirely arrested, may return after a very short time. This results chiefly from the very free communication of the vessels of different sides at the base of the brain. Blood finds its way through the circle of Willis into the internal carotid of the tied side to that part of the common trunk lying above the ligature, thence into the external carotid, and so to the face and parts outside the skull. The operation, however, having relieved the blood-pressure, and the current being very indirect, coagulation, though slower than in arteries whose branches anastomose by less patent communication, nevertheless takes place. The nearer to the bifurcation is the opening between sac and artery, the slower *ceteris paribus* will be solidification. I use the words other things equal, because a large aneurism with a small opening consolidates more quickly than a small tumor with a large orifice.

The very free communication at the base of the brain of the four vessels supplying that centre precludes any danger from loss of circulation by deligation of a carotid artery, provided the other vessels are patent. Cases have occurred of tying one vessel when the other and a vertebral were already plugged. Hence, before undertaking such operation a wise caution would inculcate careful examination into the condition of the like vessel on the other side; also, by pressing simultaneously both carotids, to gain grounds for a conclusion concerning

the patency of the vertebrals. Given free circulation through the other three vessels, we need not fear cerebral disturbance from deligation of the fourth. I consider this dread to be unfounded, the case or two in which softening of the brain was afterwards discovered, accidental coincidences.

CHAPTER IV.

ANEURISM AT THE ROOT OF THE NECK.

Low carotid, subclavian and innominate aneurism may be judiciously classed together under the name of aneurism at the root of the neck, although the last, when the commencement of the artery is affected, is also intra-thoracic. All these forms of disease are surgically somewhat peculiar, inasmuch as they can very rarely indeed be subjected to pressure (distal or direct), and the Hunterian operation is inapplicable. Very frequently a large part of the tumor lies behind the bones of the chest and shoulder, so that its outline and origin is less obvious than when the disease is on a limb or high in the neck. Moreover the aorta is frequently also involved; indeed it has more than once occurred that an aortic aneurism, creeping along the course of one of its great offshoots, has been mistaken for disease of the branch, which it only covered.

Right low carotid aneurism may originate at a sufficient distance from the origin of the artery to

render its diagnosis quite clear; as, for instance, if the lower edge of the tumor be felt above the clavicle and a little space of healthy anatomy lie between those two parts. But a pulsating tumor which occupies the lowest part of the neck, extends down behind the sterno-clavicular joint, and is felt in the episternal notch, may be simply carotid or may also involve the innominate; it may arise only from the latter artery, or may be a purely aortic aneurism.[1] The diagnosis is to be formed from a careful collation of all attainable symptoms. It can be most simply described by taking each class of case separately.

Low Carotid Aneurism.—The tumor, while yet small, is felt to beat in the angle between the sternal and clavicular portions of the sterno-mastoid muscle, and also when that muscle is relaxed, so that the finger can be passed behind its inner portion, the rounded margin of the pulsating swelling can there be distinctly made out. As the size of the aneurism increases its inner edge comes to lie inside this muscle, and may be felt on the right portion of the episternal notch. The tumor is ovoid in shape, its long axis directed upward and downward. The impulse is upward. I do not of course mean that the blood-stream can actually be felt, but the expansile wave is in that

[1] Subclavian may also in a few cases very closely simulate carotid and innominate aneurism, but the consideration of this diagnosis is for the present reserved.

direction. The pulse of the carotid above the aneurism, about on a level with the thyroid cartilage (where it is most easily felt), is decidedly weaker than on the left, as also is the beat of the derivatives —the facial on the lower jaw or the temporal ; I rely rather than on the mere weak beat of the arteries, upon their extremely facile compressibility. This peculiarity is carried even into very small branches, for if the patient's ears be nipped simultaneously and with equal pressure between the finger and thumb of each hand for a few seconds and then suddenly released, the white mark so produced will regain its colour more slowly on the diseased than on the normal side. These signs show that the carotid artery is aneurismal.[1] We now must discover if it alone be involved. The exclusion signs, as I call them to my clinical class, are these :—

There is no sign of pressure on any vein, nor, unless the tumor be very large, on any nerve ; larynx, trachea, and œsophagus are all unaffected. The radial pulses are alike and unaltered ; percussion-sounds on the parts below the sterno-clavicular joint are normal ; unless of course the lung happen to be diseased, there is no dulness over the first rib and intercostal space.

It is assumed in the above paragraphs that the

[1] It is true that some other form of aneurism may compress the lower end of the carotid, and obscure the symptoms ; these forms are detected by the signs now to be specified.

aneurismal nature of the tumor has been distinctly verified, nor is it my intention to describe the diagnosis of aneurism in general; nevertheless I would point out that it is well to give the patient a little water, and while he is swallowing to watch the behaviour of the tumor—if it rise with the trachea or remain stationary. The surgeon also should be aware that the lower like the upper part of the common carotid is in women occasionally the subject of a peculiar condition, which although anatomically abnormal, is yet not disease. I have never had the opportunity of investigating this peculiarity after death, but from study during life the condition appears to be the result of the mode in which the innominate normally divides, which is not correctly represented in anatomical works. The received idea of the bifurcation is, that carotid and subclavian arise side by side from the end of the brachio-cephalic trunk; in reality they spring, one posterior, the other, the subclavian, behind. Now in most persons the carotid runs straight from this point to its bifurcation, leaving a little space between itself and the lower part of the sterno-mastoid, but in some it bends forward over the upper edge of the clavicle, and touches, even flattens, itself a little against the fascia between the two parts of the sterno-mastoid and then swerves back again. The most prominent part of this curve pulsates visibly, sometimes even strongly, just above the sterno-

clavicular joint. The sense of touch will, better than eye-sight, distinguish this band of a perhaps slightly dilated artery from an aneurismal tumor.

Subclavian aneurism may spring either from the first or third part of the vessel; the former class of malady is frequently combined with innominate, the latter with axillary, disease. I am not aware that the second division of the vessel is ever aneurismal, unless the case be one of fusiform dilation of the whole, or nearly the whole, artery; and even then that part is less enlarged than the rest; it looks as though constricted, and it certainly is supported by the scaleni muscles. Aneurism of the first part shows itself by a tumor which generally appears under the outer fibres of the sterno-mastoid muscle (of the clavicular part); it lies therefore a little outside the place where carotid aneurism first appears. The shape of the swelling is a rather elongated oval, the long axis being transverse, the lower part of the tumor being covered by the clavicle. If the shoulder be raised, this bone glides over the tumor until the whole of a moderately small or only a part of a larger aneurism is concealed by the bone. If large, an aneurism in this situation may press the clavicle forward until subluxated.

Certain pressure symptoms are well marked. The first is usually a teasing cough and altered voice, from slight stretching of the recurrent laryngeal nerve; then the internal jugular vein becomes

distended, and may be seen engorged at the lower part of the neck, while the tributary veins are also full. This is especially the case with the external jugular, which, assuming part of the deeper vessel's office, becomes often exceedingly large. A little later the veins of the hand and arm swell, then those of the front wall of the axilla.

As the tumor increases in size, so are these symptoms aggravated. Irritation of the larynx changes into paralysis of the right vocal cord; the veins of the neck, arm, and side become fuller, and these parts may even become varicose.[1]

The radial pulse is weaker than on the other side; sometimes even it is barely or not at all perceptible.

Exclusion signs are chiefly derivable from comparing the conditions of radial and of carotid pulse on the same side. If the innominate be unaffected, the beat of the carotid is not altered; hence a pulsating tumor above the clavicle greatly affecting the radial, but not at all changing the carotid pulse, is purely subclavian—the innominate is involved if the impulse of both vessels be modified. Moreover, a purely subclavian aneurism is hardly ever to be felt in the episternal notch—an innominate can very nearly always be detected in that situation.

[1] By this time a symptom, more especially belonging to aneurism of the third part, is combined with the others, viz. pain along the arm from pressure on the brachial plexus.

The diagnosis of a subclavian aneurism springing from the third part of the vessel is very much easier. It often makes itself felt by severe lancinating pains of a neuralgic character running down the arm before any distinct tumor can be felt. The swelling lies above the middle of the clavicle; its throb is pretty strongly marked; very usually one may see in the little triangle, bounded above by the clavicle, outside and inside by the deltoid and large pectoral muscle, distinct pulsation. By passing the fingers deep in the axilla, one may generally feel the beat of the tumor, but the arm must not be raised, otherwise the axillary fascia, rendered tense, will prevent the fingers reaching to the neighbourhood of the first rib; though of course a subclavio-axillary aneurism may be felt even thus.

Carotid and subclavian aneurisms of the left side are more easily differentiated, because the absence of an innominate renders them independent of each other. The first part of the carotid, that, namely, between its origin and the sterno-clavicular joint, is only the subject of aneurism when forming part of aortic disease; the same thing may be said of the intrathoracic portion of the subclavian. Aneurism of this vessel is so rare on the left side that I have only seen one case, and this was in a left-handed blacksmith. These considerations suffice for the left side, since the other remarks of right aneurisms apply also here.

Innominate aneurism pure and simple is not a common disease, the trunk being so short that its root on the aorta, on the one hand, one or both of its branches, on the other, are involved either at first or soon after commencement of the disease. Indeed, clinical experience convinces me that many cases of innominate aneurism begin at one or the other end of the vessel. Thus, as with carotid aneurism, we encounter a high and a low form of the disease, the symptoms of which are different. Nay, more, the high form, which term connotes participation, perhaps commencement, of the disease in one or other derivative, exhibits different symptoms, according as it begins on the carotid or on the subclavian aspect of the vessel. These differences chiefly regard the results of pressure. Some ambiguity may, however, be produced by a form of aneurism purely aortic, which, springing from the front of the arch, near the root of the brachiocephalic trunk, expands in front and in the direction of the latter vessel, occupying anatomically very much the same place as the disease under consideration.

The tumor of an innominate aneurism generally occupies the episternal notch from side to side, and, even though it may not rise high, takes up the whole breadth of this space. On gently pressing the finger backward and downward, the rounded margin of the sac can be felt. After a little time the sternal end of the clavicle protrudes abnormally

and partakes in the pulsation (communicated), while the sternal and afterwards the clavicular portion of the sterno-mastoid is also pushed forward. Not unfrequently the first costal cartilage, outside where it joins the sternum, is also abnormally prominent, and throbs with the beat of the tumor. These parts are dull on percussion; there is a peculiarity in the dulness of aneurism, which should be observed, namely, in the centre it is complete, around the circumference on each side incomplete or relative, gradually as we proceed outwards merges into the clear percussion note. Downward the irresonance usually mingles with the normal aortic; further downward and to the left, with the cardiac dulness. But occasionally, especially if some dyspnœa exist, a significant resonant space lies on the sternum between the second costal cartilages, dividing cardiac from tumor dulness. Its appreciation depends on the mode of percussion. Gentle taps elicit hyper-resonance; heavier blows the deeper dulness. The condition is produced by an emphysematous lung-margin, overlying the commencement of the aorta. The pulsation is most marked where dulness is most complete, but extends even into the limits of relative dulness. Occasionally a pretty evident throb may be felt beyond the dull area. The stethoscope detects over all this space the heart-sounds with exaggerated distinctness, but they are altered in a way that has been insufficiently, if at all, pointed

out, viz., while both are heard as plainly as, perhaps even more plainly than, over the cardiac space itself, it is the second sound which more especially is exaggerated, and is often louder than the first; the thinner be the wall of the aneurism, and the freer from any lining of blood-clot, the more predominant is this second heart-sound. The pulse of the right radial, of the carotid and its branches are altered, weak and compressible.

These signs are such as we meet with in the form of disease which affects the upper part of the trunk, and either commences in or tends to carotid complication. But cases occur in which the tumor lies more outward in the episternal notch, and may be felt along a certain distance of the clavicle, the symptoms being combined of innominate and subclavian aneurism.

The pressure symptoms of innominate aneurisms are very variable, sometimes slight, sometimes remarkably severe. If the high malady be on the inner aspect, they are at first a constant teasing cough; this afterwards gives place, as the tumor grows, to dyspnœa, with paroxysms of coughing and breathlessness, that seem about to prove fatal, until relieved by discharge of mucus or muco-pus. No venous pressure is demonstrable until the disease has attained considerable dimensions. When the tumor lies outside the episternal notch, at first an abnormal voice, tending to break into falsetto, afterwards

tonelessness, then aphonia, with a tendency to "swallow the wrong way;" and about this time congestion of the left arm and of the left side of the head and neck. No dyspnœa until the tumor be large.

The low form of innominate aneurism, as it is usually combined with aortic disease, must be considered with that subject hereafter, but it will be well to point out here some remarkable peculiarities in the pressure symptoms. Firstly, the respiratory complications are those of dyspnœa and paroxysmal metallic cough without aphonia. But the point to be especially remarked is this—the pulsation, dulness, abnormally loud heart-sound, &c., are on and to the right of the middle line; the venous congestions are on the left side of the body, nor does the right participate till late in the disease. The very free communications between the cephalic vessels render this less evident in the head; but the veins of the fore and upper arm look in such cases almost varicose, and a meshwork of blue vessels overlying the left pectoral is especially striking. When the right side also becomes involved, the tumor will have become large; the amount of dyspnœa and of exclusion of air from the lungs must decide whether this participation result from pulmonary congestion or from pressure on the descending cava or right innominate vein.

CHAPTER V.

SURGICAL TREATMENT OF ANEURISM AT THE ROOT OF THE NECK.

It may be taken for granted that no one would proceed at once to the surgical treatment of aneurism, either intrathoracic or at the root of the neck, unless rest, diet and medicines had failed to produce amelioration, or rather some lasting benefit. The word lasting is used here because, if an aneurismal patient be taken from his labours or amusements, be kept at perfect rest, be debarred from stimuli, have a dry, unexciting diet, and be rigidly guarded from everything which can possibly quicken the action of the heart, the aneurism will throb less violently, and, since the blood-current is less potent, will probably decrease in size from mere elastic contraction of the wall. I believe this happens, unless the tumor be very large and its walls very thin, in every case when first placed under such system. Moreover, in a certain number of these cases the improvement is progressive, and cure by consolidation takes place. Other patients are improved for a

time, what is called "relieved"; they pass out of care, and when they begin to move about again, all the symptoms with the disease recur. Another set of patients experience some immediate benefit from the change in their mode of life for only a few days, after which, even while the treatment is going on, the tumor resumes its former rate of growth.[1] Under these two last conditions surgical interference is not justifiable merely, it is obligatory.

Low carotid aneurism does not permit obstruction of the artery either by pressure or ligature anywhere between its origin and the sac. Hence we are restricted in treatment to a tract of the vessel beyond the disease, to what is called the distal method, for which, since no branch is given off from its whole length, the common carotid is peculiarly adapted. Distal pressure on the carotid is even more unpromising than proximal, chiefly because it has to be applied higher, where indeed the patient cannot possibly bear for sufficient length of time compression of the vessel against the vertebræ. The only feasible method would be that practised by Rouge, viz. placing the thumb under the front and two or three fingers under the back edge of the sterno-cleido-mastoid muscle, and obstructing the artery by nipping it rather than by pressing on it.[2] Such method

[1] The rest and diet treatment of aneurism is more fully described at p. 94 *et seq.*

[2] Rouge's case was cured in 136 hours, viz. eight hours during seventeen days.

might be tried when we can with certainty procure a large and steady staff of assistants; no one could nip so deep a vessel tightly enough to sufficiently obstruct circulation for more than a very few minutes, and could not repeat even this very rapidly. The possibility of using complete compression while the patient is entirely or partially under the influence of an anæsthetic must not be omitted; but I confess that to employ such treatment to the carotid artery would fill me with a great dread, lest the spongy (passive) clot which, it is believed, first results from this mode of cure might be washed, pressure being removed, piecemeal into the brain. I should consider deligation even with silk less dangerous.

But if rest fail, if, as is most probable, pressure prove useless, or cannot be borne, we have no resource but to apply a ligature on the distal side of the sac. We have in England a singular passion for attributing British work to foreign names. The operation was first practised and formularised by Wardrop.[1]

[1] In a subsequent page (p. 56) Brasdor's suggestion is called "crude"—perhaps rather a strong word; but I wish to accentuate the fact that his proposal was simply in reference to any mechanical obstacles there might be in the way of proximal deligation as a carpenter finding a difficulty in shortening the board at one end might apply his saw to the other. He took no account of branches given off, of their position in regard to the ligature and to the sac, nor appears to think one vessel less amenable to this method than another. Wardrop, although with mistaken modesty calling his proposal for treating carotid and innominate aneurism a "revival of Brasdor's method," formulates distinctly these various

While the proximal operation for high carotid aneurism has generally to be performed low down on the common trunk, distal ligature should be applied pretty close to the bifurcation. Were a silk or even a carbolised catgut ligature used, I would recommend a longer distance, to avoid any hemorrhage from the distal end by the reverse current, but with the flat ligature half an inch below the termination of the common trunk is more than enough.

Ligature of the carotid used to be a very fatal procedure; but of late the operation has been so frequently performed with success, and all the circumstances are so changed, that statistics of only a few years ago are useless at the present time. The operation is facile; I would only caution him, who has to do it for the first time, to take care that his incision among the deeper parts is on the *inner* margin of the vessel, and that he avoid certain large and perhaps distended veins, which run from the larynx and thyroid body to the internal jugular. It is very embarrassing to have the wound constantly filling with blood. Therefore, when the portion of the fascia which, running from the trachea, covers the arterial sheath has been split upward, the finger or handle should push these vessels up and down, the blade being only used to open the sheath. Thus the

points, and is in reality the founder of distal deligation. Desehamps and Astley Cooper performed what really is Brasdor's operation—on the femoral artery; both cases proved fatal.

operation becomes a very bloodless one, and the surgeon sees his work.

After a distal deligation, pulsation in the tumor goes on for a time; nor do I know that at present we have sufficient data whereby to fix the exact period at which it should cease. In certain cases[1] the sac will, even though consolidated, throb with communicated pulsation, imparted to it by the innominate, on which, if very low, the carotid aneurismal tumor is sessile.

Subclavian Aneurism.—The high mortality, indeed one might say the almost invariably fatal result, of subclavian aneurism has been set forth by Mr. Poland[2] and by Dr. Koch,[3] nor does it appear that hitherto art has greatly affected the result one way or another. In Koch's tables, all cases (14) of deligation in the first part of the subclavian which survived the immediate effect of the operation died of secondary hemorrhage. Of twenty-three cases left surgically untreated, three are very doubtful, four results are unknown; in one spontaneous cure occurred, fifteen succumbed. As all cures are almost certainly published, the four unknown results may be suspected to have terminated fatally. The one case of spontaneous cure commenced after a severe attack of enteritis; the limb remained

[1] See Case V. and Case VI.

[2] *Guy's Hospital Reports*, third series, vols xv. xvi. xvii.

[3] *Langenbeck's Archiv*, vol. x. p. 195.

useless.[1] On the other hand, a table giving twenty-seven cases of deligation behind the scalenus requires for our purpose considerable supervision.[2] Among them, are but three of true subclavian aneurism ; of these, two were cured.

It will from this very abridged account be only too easily gathered that we have now to do with a most formidable disease. Nevertheless, it is one from which, I hope, the plan of tying arteries without division of their coats may eliminate a large portion of its mortality. But other means, medical and surgical, should first be given a full trial. Proximal pressure can hardly be applied ; while the large and important branches which are given off by the vessel beneath the clavicle render distal pressure, theoretically at all events, very doubtful ; yet a combination of distal and direct pressure would be the means I should employ, did a case of pure subclavian or of subclavio-axillary aneurism present itself. For the distal I would apply an Esmarsch bandage to the arm ; for the direct, would either (keeping the patient sitting semi-erect in bed) lay a shot-bag partially

[1] The possible relationship between formation of clot and a severe inflammatory disease is suggestive.

[2] English subclavians terminate at the lower border of the first rib ; German ones at the inferior edge of the pectoralis minor. It is only fair to state that, in Mr. Poland's papers above referred to, eleven out of thirty-five cases not surgically treated are given as cured. On these eleven, both Mr. Poland and Mr. Holmes (*Lancet*, 16th November, 1872) remark that in some the disease, in others the cure, is more than doubtful.

suspended upon the shoulder, or use a combination of elastic bandages, which I have tested on sound persons, but whose description would here occupy too large a space. Medicinal treatment and ice should not be neglected. These means ought to have a full, nay, an exhaustive trial; however firm my faith in non-division of ligatured arteries might be, my patient should not be subjected to an operation hitherto so perilous, unless absolutely necessary; nevertheless, if in spite of treatment the aneurism still grow, operation should not be delayed until impracticable. If deligation be decided on, we have a large choice before us. We may, according to the exigencies of the case, tie the innominate, the first, second, or third part of the subclavian. Here a few observations must be interpolated. The secondary hemorrhage, which in all cases that survived long enough occurred, which indeed destroyed all of those cases save one, came apparently always from the distal end of the severed artery. The one who survived was saved by tying a communicating vessel on the distal side (case of Smyth, of New Orleans). Therefore the bleeding has not resulted from power of a blood-current so near the heart, for there the vessel was sealed; but simply from failure of clot; probably, indeed, the stretch of artery just beyond the ligature remained empty, the return blood from the vertebral passed into the intercostal internal mammary thyroid axis,

&c. If then the vessel between the artery and first branch be either empty or filled merely with stagnant, loosely-clotted blood, and if the bleeding come from here, it is abundantly evident that, were the arterial coats entire, no hemorrhage could occur. The question as to whether the aneurism will be cured may best be answered by experience, failing which by a deduction as to the amount of blood-pressure after a circuitous course round by the vertebral and base of the brain.

A question, which the condition of artery so frequently present in subclavian aneurism, forces to the front arises here, namely, how to act if the vessel be found diseased. A wider experience than has yet been gained, or than can probably ever fall to the lot of one man, must decide what amount of morbid change should force us, having exposed the vessel, to forego its deligation. As at present taught by observation and experience (see Case IV.), I should not abandon the ligature for atheroma merely, nor even for a certain amount of dilatation, but should shrink from tying an artery where it was calcified (ossified) throughout its circumference. Could no part be found sufficiently flexible to bear a ligature without breaking, deligation should be omitted. In tying a diseased vessel, the utmost gentleness in passing the aneurism needle must be used, and the ligature should be drawn only just tight enough to stop pulsation in the tumor. From *à priori* reasoning, indeed, one would say that, if advanced arterial

degeneration justify much fear of injury to the vessel, it may not be necessary to suppress altogether the throb of the tumor. It would seem that the tube puckered and narrowed to a mere rift by the ligature would afford an excellent surface for, and would soon get occluded by, blood clotting. Or if that did not take place, pressure treatment, be it remembered, generally succeeds best when a certain permeability in the artery remains.

And now we will return to the choice of operation. If the symptoms, as given on p. 38, lead to the conclusion that the aneurism springs from the distal parts of the artery, the internal operation should be chosen; or, if more extensive disease be diagnosed, the innominate may be tied. For either purpose the first incision should begin on the inner margin of the sterno-mastoid muscle about two inches up the neck, and terminate on the outer side of its round tendon of origin on the clavicle; thence a second incision should run along that bone to the outer origin of the muscle. The external jugular vein will not be cut at this stage, and in turning up the flap it is wise not to wound that vessel; it should be loosened from its connections, and either turned outward or, if necessary, must be tied with catgut[1] in two places and divided. Then the clavicular origin of the sterno-mastoid may be severed on a director, or freely, keeping the scalpel

[1] The flat ligature will not hold on the end of a divided vessel.

close to the bone; it is very rarely necessary to cut through the sternal part. The edge of the sterno-thyroid and hyoid muscles are now exposed and divided on a director insinuated beneath them. The fascia underlying these can generally be torn with the finger, the more easily if a piece be pinched up in the forceps, and a little rift made with the knife whence the tear may commence. The finger now comes on the bare carotid; tracing this downward, one feels the divergence from it of the subclavian and upon this the little round string of the vagus nerve. The innominate vein is lower and further to the right; the jugular also is considerably out of the way to the right. By depressing the patient's head, one can, if it be desirable, lay the fork of the two arteries bare enough to see the state of the vessels, and one may even by care dissect the end of the innominate almost clean. Therefore now, the surgeon has better grounds than before he saw the part for selecting his operation. If the carotid as well as the subclavian be involved, he should tie the innominate as low as he can. The same should be done if the first part of the subclavian be diseased; but if none of the vessels now in view be affected, and therefore the disease verified as seated on the second or third part of the subclavian vessel, the internal portion of that artery may be tied. It would be well to remark here how necessary it is to keep the needle close to the

artery and out of the way of the pleura; indeed, it is better to push that membrane down and protect it from the needle with the forefinger of the left hand. This observation refers chiefly, but not entirely, to the subclavian.

With regard to the innominate, I would say that the aneurism needle passed from without encounters behind the vessel a very strong piece of fascia which cannot be reached with the knife, and with difficulty pierced by the blunt needle; yet, keeping the finger of the other hand on the inner margin of the artery, one may make the instrument push the structure before it until it come near enough to be scratched through.

Another consideration, which recommends itself to common sense, but has hardly been tested by experience, is the ligation of other vessels which might interfere with coagulation of blood in the sac. Thus if disease involving the first part of the subclavian necessitate deligation of the innominate, ought we, the carotid being sound, to tie that vessel also? Or, if we ligature the first part of the subclavian, ought we also to occlude the vertebral? The former question demands, I think, of necessity an affirmative answer. Blood will at once, when the innominate alone is ligatured, find its way through the carotid into the subclavian in quantity large enough to compromise the cure. The ligature on the carotid does not complicate the operation, nor

add to, indeed, it rather subtracts from, the danger.[1] The latter question cannot be answered so positively; the site of the disease may render any approach to the vertebral very dangerous; but if this be not the case, one can, having laid bare the inner portion of the subclavian, expose the vertebral with the greatest ease by turning aside the scalenus, not close to the rib, but about an inch higher, where one can most readily find the artery, and where the phrenic nerve is out of the way. So many matters must influence the decision as to adding or omitting this precaution that it cannot be inculcated, it must be left to the judgment of the operator at the moment. Much will depend on the conditions of the disease, period which the operation has already lasted, state of the patient's pulse, the way he is bearing the anæsthetic, and whether or no, blood conceal a fair view of the situation.

The operations on the vessels behind the clavicle and sterno-clavicular joint are among the most

[1] Of course no blood finds its way up the carotid to the brain, hence no fear of injury from the additional ligature to that organ; the down current from the brain and other parts of the head is what must be guarded against. Exactly the same thing may be said of the vertebral artery; but I am not prepared to recommend the same course, partly because it could only be effected by a wider incision and getting to the outer side of the jugular, in fact performing two operations, but chiefly because the innominate ligature is for aneurism on the inner parts of the subclavian, in which case the vertebral artery, being covered by the sac, would probably be unapproachable.

arduous in surgery, requiring both steadiness and a certain courage. They must be very cautiously, but at the same time rapidly, performed; it is distressing to see among the list of cases several fatal results attributed to shock and exhaustion. Sometimes, however, either from anatomical peculiarity or state of disease, the surgeon meets with all but insuperable difficulties, greatly delaying the completion of his work. Given, however, that the operation have been performed in a moderately short period, and have been properly selected, there is no reason why the patient should not get well, *provided the ligature have not divided any of the arterial coats.*

To place a ligature on the subclavian between the scaleni, a slight modification of the procedures for tying the same artery on the first rib is necessary. The incision must extend a little more inwards; the external jugular vein must be tied and divided; the outer fibres of the sterno-mastoid, together with the strong fascia behind that muscle, must be severed. The loose cellular tissue overlying the anterior scalenus is easily disposed of, and the phrenic nerve, as it crosses very obliquely that muscle, must be brought into view. The artery emerging from behind the scalenus is now seen; between it and the muscle a curved director is passed, and the outer fibres of the latter divided when the safety of the vessel itself and its branches has been ascertained, and the phrenic nerve has been drawn inward. This

is the highest part of the subclavian, the pleura is just below it, and several important branches take origin here; of these it may be thought desirable to secure one or more; that will depend on their position with regard to the ligature. The support of muscular fibres has frequently this effect on the vessel, namely, while fusiform dilation exists to right and left, this little tract is healthy; the condition might be called an hour-glass aneurism. If the parts internal to the place of ligature be dilated, it will be safer to tie also the vertebral, which, with the incision already made, is quick and simple, but the phrenic nerve must be carefully drawn aside.

I do not see what condition of subclavian aneurism would be benefited by ligature of the third part of the artery,[1] for there are too many branches between its origin and this point to allow the operation to resemble Wardrop's, though it is not unlike Brasdor's rather crude proposal. Nevertheless, for other diseases, now to be considered, this operation has its very distinctive value.

Innominate aneurism and its allies have ever been to me a subject of very great interest, and my thanks are due to many friends in the profession for opportunities of increasing my clinical studies. This short trunk is liable to three forms of the disease, that

[1] In axillary aneurism, unless very low, the vessel should be ligatured between the scaleni.

which is limited to the artery itself (probably uncommon), that which also involves either or both its derivatives, and that in which the aorta participates. Although the mode of treatment does not materially differ in these several conditions, yet the rationale, the prognosis, and the surgical history of each are so various that I propose to exclude from the present section the last form of disease, taking it in the sequel with aortic aneurism.

In whatever part of its course the innominate artery be aneurismal, surgical treatment other than the ligature is hardly admissible, and the possibility of applying the method to such disease is of very modern date, viz. from 1828, when Wardrop suggested tying the carotid and the third part of the subclavian for innominate aneurism (*loc. cit.* p. 58); unhappily in the case (Mrs. Denmark) that next presented itself, he had reason for believing that the right carotid artery was already obliterated, and only tied the subclavian. He never seems to have had an opportunity of carrying his full idea into practice. There is, too, no doubt that Wardrop in this recommendation let slip the principles he so ably laid down for the "new operation," viz., that no vessel may intervene between the ligature and the sac; but, although perhaps illogical, he was very wise, for deligation of the first part of the subclavian has, with the ligature hitherto used, proved invariably fatal. Moreover, if the aneurism be considerable, there will be in every

or almost every case great doubt whether that portion of the subclavian artery be accessible. Although Wardrop had no opportunity of putting his proposal into practice, several surgeons have done so. Omitting from the list of eight cases quoted in Mr. Holmes' Lectures[1] three as inappropriate here, and adding one (Ensor) proving fatal, which has occurred since, we had in 1878 six cases, none of which had practically proved Wardrop's view to be correct. In August, 1877, I operated on Robert W. with success. The aneurism was cured, both the carotid and subclavian obliterated up to the ligature, but the man, in the worst day of November, already with some bronchitis, exposed himself to severe cold and wet, and contracted severe broncho-pneumonia. Hence a representation of the parts are given in this book.[2] Later in that year, I operated on the same day on Laura G. and on George H. The latter died;[3] the former made a slow recovery. In January, 1878, I performed double distal deligation on Catherine H., who also recovered. In the meantime, my

[1] *Lancet*, vol. ii. 1872, p. 37. The cases left out are Hobart's and Rossi's, because they tied the first part of the subclavian, and Heath's, because the aneurism turned out to be purely aortic, and as such will be discussed in the sequel.

[2] By the kind permission of the Council of the Medico-Chirurgical Society.

[3] It may be said that the experience since acquired has shown me that the case was hardly fit for operation.

friend, Dr. Kelburne King, of Hull, had performed the same operation, but without success.

The table, then, of double distal ligature for innominate aneurism stands thus :—

Maunder	...	Died.	
Sands ...	...	Recovered operation.	No benefit.
Durham	...	Died sixth day.	
J. Lane ...	...	Recovered operation.	No benefit.
Holmes ...	...	Ditto.	Ditto.
Ensor ...	...	Lived sixty-five days.	No benefit.
Barwell ...	...	Cured.	
King ...	...	Died, suppuration of sac.	
Barwell ...	...	Died in thirty hours.	
Barwell ...	...	Cured.	
Barwell ...	...	Cured.	

There are, it will be seen, eleven cases in all. The singular good fortune to have had of this number four operations for innominate aneurism has, I hope, given me considerable power of judging where such procedure is likely to prove available. The still more singular good fortune which causes my name to be written against the only three successful cases is, in great measure, due, I believe, to the views I entertain about non-division of the arterial coats; for though these vessels were all tied with catgut, yet none of their coats were, I am positive, divided.[1] The new ligature, more valuable

[1] See *Med.-Chir. Trans.* vol. lxii. p. 229, where I strongly insist on the non-necessity of tying soluble ligatures tight enough to cut through the outer and middle coat.

than catgut, and more easily used without cutting any part of the vessel, will give a means of adding a long list of successful cases to the above record.

Perhaps my wide experience of tying subclavian arteries in their third part may warrant my saying a few words which will facilitate to others the operation. Mark well the spot where the edge of the sterno-mastoid arises from the clavicle, and take this to be the inner end of the incision, or, if it extend unusually far out, let the first cut begin a little inside it. Draw the integuments down as usually recommended, and cut on the bone. Let the parts now rebound just so far as allows the wound to lie along the upper border of the clavicle, and use this as one does a ruler, carrying the knife with its flat on that margin, but taking care to sink it only to *half* the depth of the bone.[1] Thus the strong layer of fascia stretching from the sterno-mastoid to the trapezius is safely divided, and beneath this the tissues loaded with veins are lax and soft, so that, feeling the outer edge of the scalenus, one can in most cases tear and push them aside with the finger, and with slight use of the nail isolate the artery in question. I have in two cases done nothing more with the knife than make these two cuts, one on, one just above the clavicle. If the parts glide feebly before the finger, but do not give way, let the head be turned to the

[1] Of course one refrains from cutting the external jugular, or, if it be severed, ties it at both ends instantly.

other side, and the shoulder depressed. The areolar structures thus rendered tense will probably become manageable. If, however, they be too strong to be dealt with thus, unless in part divided, do not make an incision, but, looking at a place free from veins, pinch it in the forceps and notch it with the knife. From such a starting-point one can readily with the finger procure a sufficient opening. By this means one almost entirely avoids bleeding, and can see the vessel, when bared, perfectly and clearly.

Case VII.—Robert W., aged forty-five, labourer in a foundry, admitted under Dr. Pollock, 24th July, 1877, with aneurism at the right root of the neck. As shown in the accompanying plate, the tumor was very large, mounting as high as the cricoid cartilage. Pulsation could be felt even down to the lower border of the second rib. Dulness extended over the inner third of the clavicle, then in a semicircle from that place over the first intercostal space and second rib, till it mingled with the cardiac dulness. The heart was so displaced that it beat $1\frac{1}{2}$ inch outside the nipple, while strong epigastric pulsation showed considerable downward displacement. Dr. Pollock treated him by the best resources known in medicine, but the tumor continued to increase, and became conical like a pointing abcess. On the 13th August compass and tape measure show the size of the tumor, and give some idea of

the projection, as also does the diagram procured by

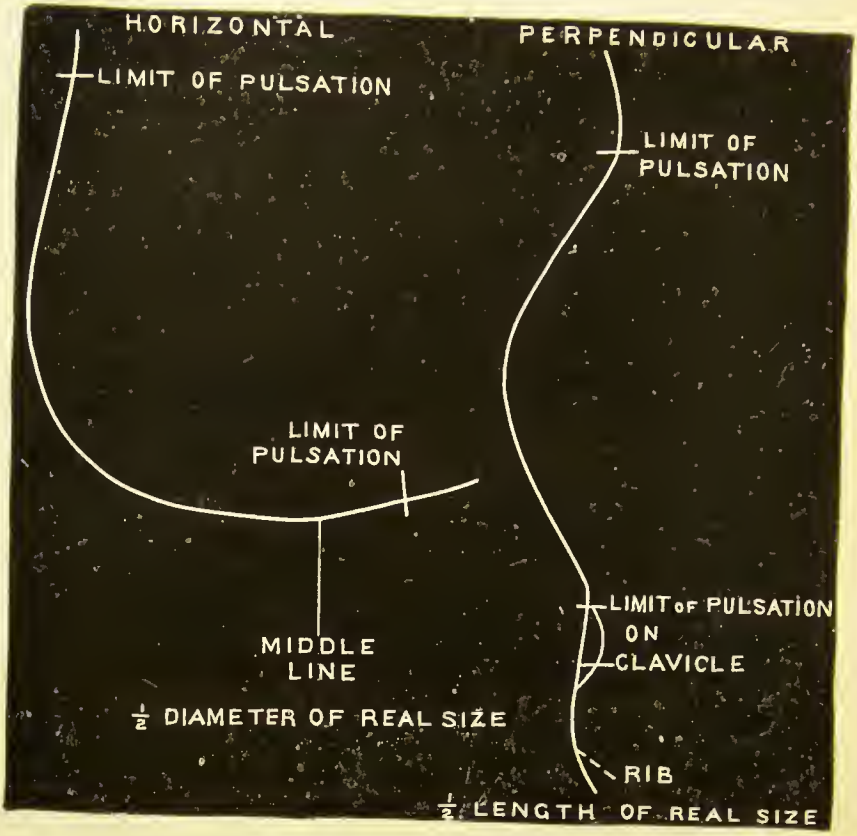

FIG. 1.—Diagrammatic shape of Tumor. Robert W., from a photograph taken immediately before the application of the double distal ligature.

moulding a lead wire to the neck, and tracing the shape on paper.

HORIZONTAL.

Tape measure from side to side $4\frac{1}{2}$ inches.
Compass ,, ,, $6\frac{1}{8}$,,

PERPENDICULAR.

Tape measure from top to bottom $4\frac{1}{2}$ inches.
Compass ,, ,, $3\frac{3}{4}$,,

Since the aneurism in the neck was remarkable in size, I had a photograph taken. The subjoined engraving is a very faithful representation of the man's appearance two days before the operation.

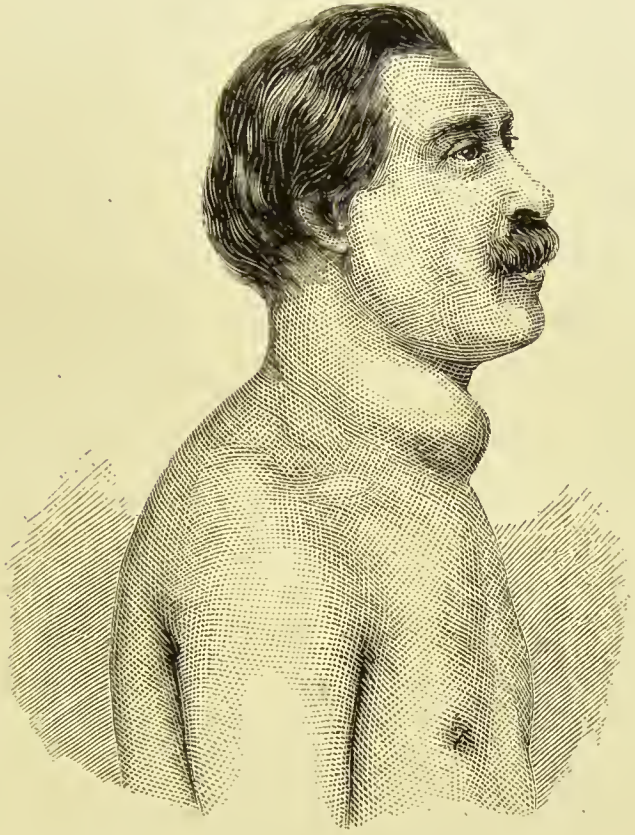

Fig. 2.—R. W., August 12, 1877.

August 14.—I tied the common carotid immediately below the bifurcation (the lowest part that could be reached), and then the third part of the

subclavian. The former operation was rendered very difficult by the high position of the tumor, and further embarrassed by an abnormally large thyroid artery, which simulated the margin of the aneurismal sac, had to be dissected clean, and drawn out of the way. The ligatures, however, were passed when the vessels were exposed and drawn with only sufficient tightness to check pulsation.

16*th.*—The patient passed a good night after the operation, and had neither fever nor pain.

21*st.*—Patient's condition very good. The intra-thoracic pulsation greatly decreased, and the apex of the heart nearer its normal place.

25*th.*—Changed his diet to the dry system.

September 3*rd.*—The diet having produced considerable irritability, with somewhat excited heart action, I changed it to the usual No. 3 diet of the hospital, only enjoining him to drink as little as possible.

11*th.*—The measurements of the tumor are as follows:—

	Tape.	Compass.
August 21st	$4\frac{3}{4}$	$3\frac{1}{4}$
,, 30th	$5\frac{1}{4}$	$3\frac{3}{4}$
September 5th	$4\frac{1}{2}$	$3\frac{1}{8}$
,, 8th	$3\frac{1}{2}$	$2\frac{3}{4}$
,, 9th	$2\frac{1}{8}$	$2\frac{1}{4}$
,, 10th	$2\frac{1}{4}$	$2\frac{1}{8}$
,, 11th	$1\frac{3}{4}$	$1\frac{1}{2}$

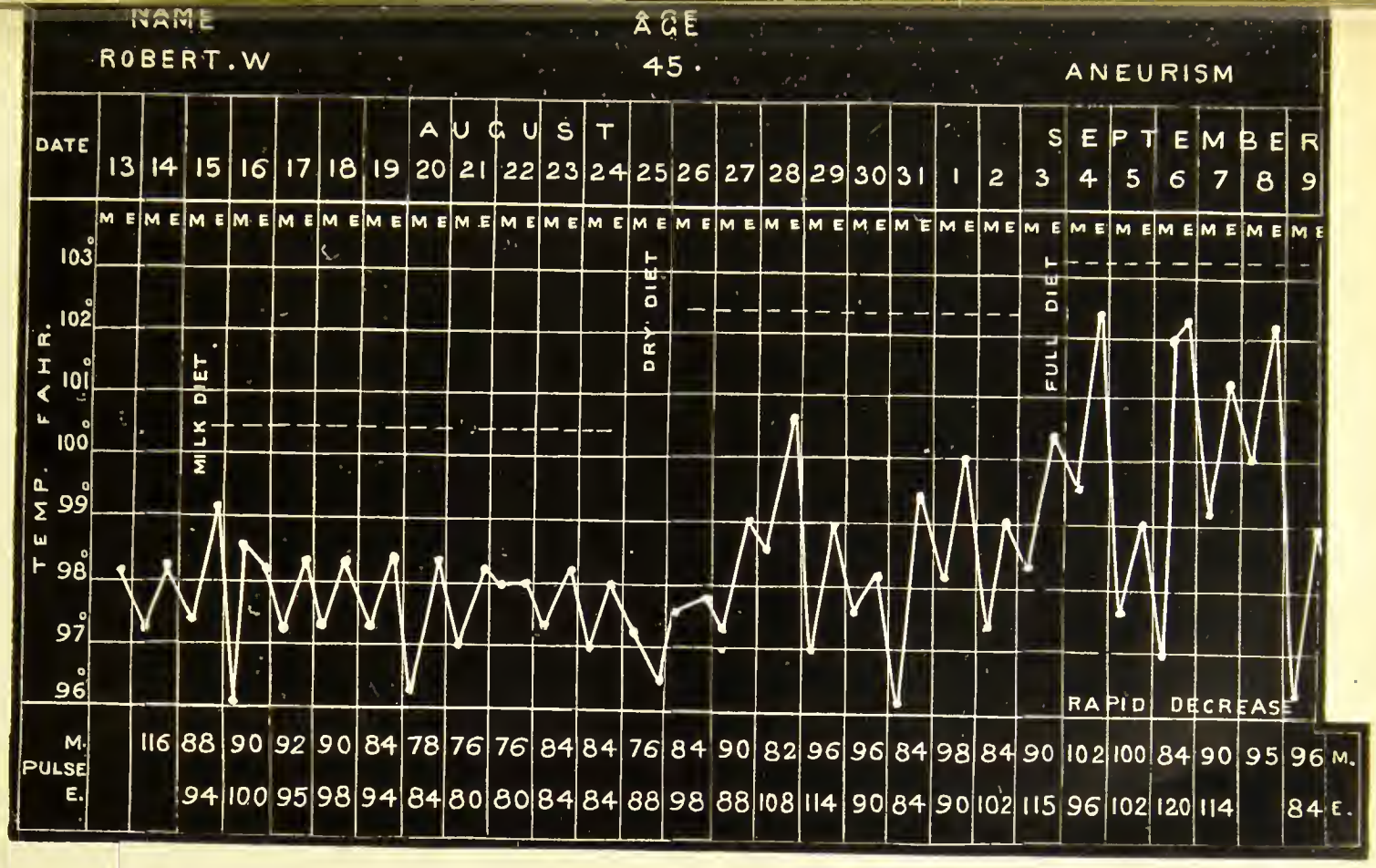

Fig. 3.—Temperature Chart.

The temperature chart shows a relationship between diet, pyrexia, and changes of the tumor, which is very suggestive.

October 1*st.*—On my return to town I found the man in very good health, and without visible enlargement at the root of the neck. On passing the finger behind the sterno-mastoid muscle, one could feel, posterior to the sterno-clavicular joint, a tumor about the size of a pigeon's egg, quite hard, but with a pulsation which might be intrinsic but more probably was communicated to the solidified aneurism by the aorta. There was neither radial, brachial, nor axillary pulse; yet the limb was warm and well nourished. A feeble pulsation was sometimes perceptible in the temporal artery.

The condition of the chest, as kindly furnished me by Dr. Pollock, was as follows:—"There remains a slight cough, but not, the man says, as much as he has had ever since he returned from the Crimea; the mucous *râles* have disappeared. Over the right side of the manubrium sterni, and about half an inch outside it, there is some dulness, and over this, and a little further out, the heart-sounds, more especially the second sound, are too distinctly heard, and with a slight ring: no pulsation is to be felt at this part. The heart has returned to its proper place, its beat is of normal force; the second sound is somewhat dull and muffled, in all probability from thickening of the aortic valves."

Dr. Green, I may remark, thought the physical signs indicated contraction of the lumen of the aorta

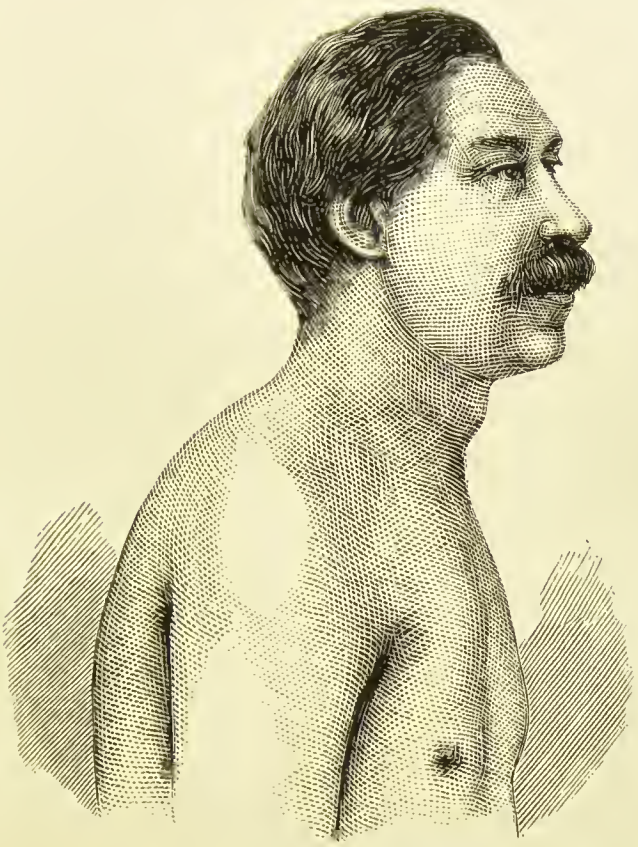

Fig. 4.—Robert W., from a photograph taken seven weeks after the operation.

rather than increase. Air, he observed, entered the lungs quite freely.

On the 12th the photograph, whence the engraving, was taken. On the 23rd the man was shown

to the Fellows of the Medico-Chirurgical Society. The next day left the hospital well, and intending to obtain lighter work in his old employ.

On the 20th November this man returned to hospital to go through some formal business. I happened to see him; the weather was most inclement, with showers of snow and sleet; he was very thinly clad, and had some bronchitis. Dr. Pollock was good enough, at my request, to readmit him; but two days afterwards, annoyed that the house physician would not allow him as much brandy as he desired, he left in a rage, walked home through a heavy shower, and his wife being away, he sat for four hours wet through in a fireless room. When his wife came back, he was blue, and almost pulseless. He died two days afterwards of acute broncho-pneumonia.

The *post-mortem* showed the lungs to be markedly œdematous, a quantity of clear but aëriferous serum bubbling forth on pressure; there was a good deal of hypostatic pneumonia; the portions of lung so affected felt very hard, yet broke down readily; there were no cavities, no new deposit or pathologic breaking down of tissue. The bronchi, even to very minute divisions, were strongly congested, and filled

with mucus or muco-pus. Cerebral and abdominal organs healthy. The heart, aneurism, &c., were removed entire. In their subsequent examination I was assisted by my friend, Mr. Cantlie.

The trachea and œsophagus were pressed by the tumor to the left side, the former being somewhat flattened from the right, but not enough to cause any obstruction to the entrance of air; it was also pressed backward, so as to lie in a plane a little posterior to the carotids. Moreover, these tubes were twisted, so that about the level of the top of the sternum, where the twist is greatest, the œsophagus lay to the left and a little in front of the trachea, whose non-cartilaginous portion looked wholly to the left.

The aneurismal tumor lay to the right of and above the first part of the aorta; looked at from the front, it was seen to extend above the first bend of that vessel, covering the lower part of the carotid and subclavian arteries. Lying against its left side was the left vagus nerve, slightly flattened, and, perhaps, a little deflected. Winding round its lower part was the left innominate vein, elongated and bound to the wall of the tumor by condensed fibrous tissue.

The veins of the right side were peculiar; the subclavian joined, about an inch from the heart, a large venous trunk formed by the right internal jugular with thyroid axis branches, and by the left

innominate. Thus, the right subclavian appeared to enter almost at once into the auricle. Whether this was an original peculiarity or a modification by disease, I cannot say with certainty, but believe that it was the former, since in this case the right subclavian entered the larger venous trunk on a level considerably lower than that of the left innominate.

The aneurism sprang from the junction of the first and second part of the aorta; extending upwards and to the right, it involved the front wall of the innominate together with the roots of the right carotid and subclavian. It was rather larger than a tennis ball, and had a subsidiary projection upwards and outwards, which was divided from the bulk of the tumor by a broad shallow groove, probably the impress of the clavicle. The back part was moulded on the apex of the lung. In texture the whole mass, after a certain immersion in spirit, was as hard and unyielding as a solid piece of leather. (*See frontispiece.*)

The whole tumor was cut through from before backward; it was then seen that a globular cavity, communicating freely with the aorta, still existed. This was perhaps a little more than an inch in diameter; it was surrounded by very firmly laminated clot of variable thickness, and in front, the thinnest part, it measured over a third of an inch. At the back it was an inch and a half thick. The

subsidiary part was entirely filled up, constituting a mass of firm fibrin about two inches in thickness. The walls of the aneurism on the section surface were distinguishable.

Below the mouth of the cavity, therefore, on the wall of the aorta itself, the openings of the left carotid subclavian were seen to be rendered somewhat oblique and elliptical by pressure.

The innominate subclavian[1] and carotid were obliterated, firmly plugged by coagulum, which on the section of one of them had a pink colour like the lean of ham.

On the subclavian the remnants of two ligatures might be seen like delicate shreds of connective tissue; there was no wound or scar on the outer coat of the vessel. The same may be said of the right carotid, except that the trace of only one ligature of course was found.

The position of the trachea and œsophagus, together with the almost spiral course of the left innominate vein round nearly to the back of the tumor, show that also the thoracic part of the aneurism must have been very much larger before operation than for several weeks previous to death.

[1] By some misfortune, in the very dark room where the *post-mortem* was made, the subclavian was cut through about the beginning of the second stage, but the rest of the vessel still attached was brought away, and the accident was not discovered till afterwards.

Lastly, I may direct attention to the large quantity of firm organised fibrin deposited in the aneurism, to the comparatively small size of the cavity still existing, and to the fact that, as no vessel leads out of it, there could not be any stream of blood within it. It will be conceded me that, had this patient been of more tractable temper, had he either remained in hospital or been moderately prudent out of hospital, the whole tumor, since it had no thoroughfare, and since such strong walls could neither dilate nor burst, would have become of mere necessity, filled up; in fact, that, although the man died of an intercurrent disease brought on by his obdurate indocility, his aneurism was cured.

Case VIII.—Catherine H., aged 27, was placed under my care at Charing Cross Hospital on the 10th Jan. 1880, with aneurism of the innominate and origin of the carotid and subclavian. She was slight, feeble-looking, suffers from some menorrhagia, but otherwise her functions are well performed. She got out of breath on very slight exertion, and had a constant teasing cough, especially when she lay down. The sternal and clavicular portions of both sterno-mastoids were widely separated; in the right interval a pulsating tumor, looking about as large as a cobnut, was visible. To the touch the tumor seemed larger; its pulsation could be felt inside the sternal portion of the muscle, as also under nearly all the clavicular part. By so

placing the head as to relax this muscle, one can grasp the tumor between finger and thumb and detect its aneurismal character. The pulsation limit just above the clavicle was an inch and three

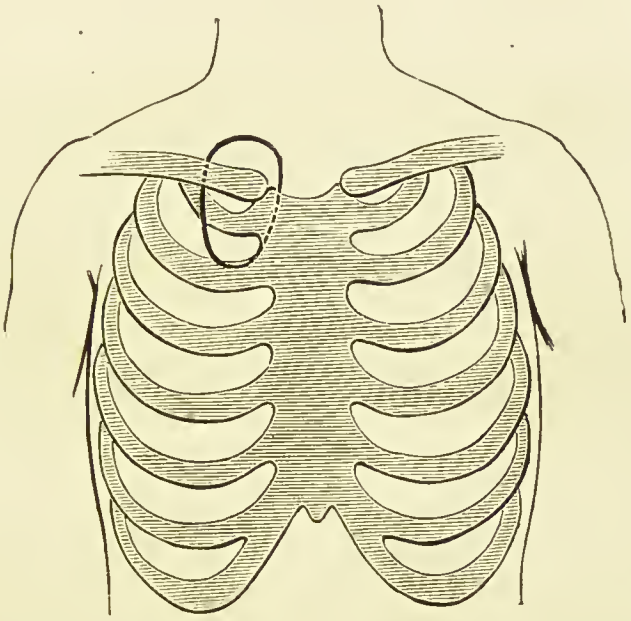

Fig. 5.—C. H. Area of Pulsation.

quarters broad and nearly an inch high. Pulsation could also be felt beneath the clavicle, and on any slight exertion in the first intercostal space down to the border of the second rib. Percussion notes were dull on the inner two inches of the clavicle and in a semicircle extending down to the first rib. On all this part the second heart-sound was remarkably loud, with a dull but somewhat ringing thud.

Pressure symptoms, except the cough above referred to, were not marked, but over the left pectoral the veins were more strongly marked than on the right side. The sphygmographic tracings are peculiar, but not very characteristic. I am indebted for them to my friend Mr. Wickers.

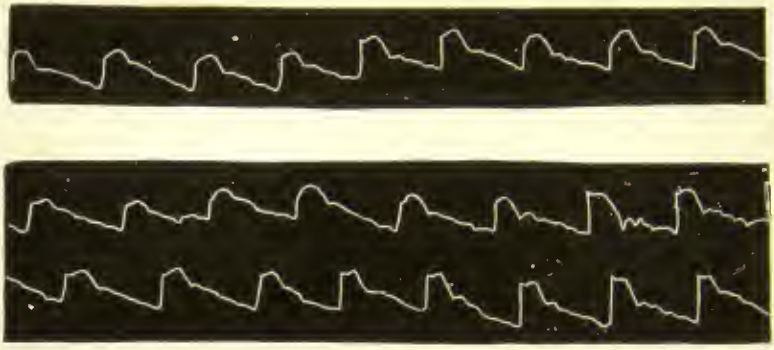

Fig. 6.—Sphygmographic Tracings.

January 17*th.*—Performed double distal ligature.

23*rd.*—She has gone on perfectly well. At this date there was a slight flicker at the radial pulse.

29*th.*—Radial pulse sometimes present, at others imperceptible.

February 27*th.*—Nothing to remark, save that on the proximal side of the carotid ligature some pulsation continued. The temperature chart shows how little disturbance was produced by the operation.

April 1*st.*—A thorough examination showed the following condition. All pulsation about the chest-wall had entirely disappeared. Percussion dulness

reached barely an inch outward on the clavicle, and about half an inch below that bone. Heart-sounds rather too loud over a somewhat larger space; the

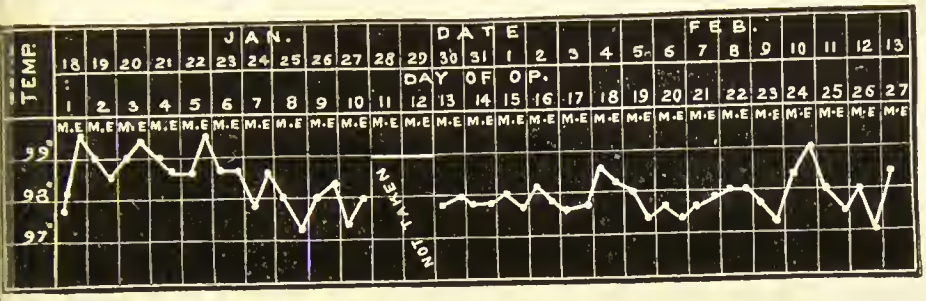

Fig. 7.—Temperature Chart.

second sound not specially accentuated. The pulsation above the clavicle still continued. On relaxing the sterno-mastoid, one can grasp this pulsatile tumor between the finger and thumb; it does not expand with the beat; the front part is solid, but there seems a non-solidified portion at the back.

July 22nd.—Discharged in above condition, save that ratio between heart-sounds were normal in upper part of chest.

November 5th.—C. H. presented herself at the hospital, and was examined by Dr. Pollock and myself. She had no cough or difficulty of breathing, but could run up and down hill with ease. The right upper chest and clavicle were resonant on percussion; the heart-sounds, a little too audible at this part, were normal in their ratio, and had quite lost the metallic ring or thud which was so marked previous

to operation. The radial pulse (right) was very small; there was no carotid pulsation above the seat of ligature.

On looking at the root of the neck, a rather wide pulsation was visible, the greater part of which was undoubtedly venous; but on feeling behind the sterno-mastoid, a pulsatile tumor was perceptible, on which no further remark than that in the report of the 1st April is necessary, except that it had somewhat decreased.[1]

The case of Laura G. will be more usefully related in the next chapter.

[1] This patient was shown at the Med.-Chir. Society. None of the Fellows who examined the patient were able to explain the cause of this singular pulsation otherwise than I had verbally done —that the aneurism had consolidated with the exception of a narrow *cul de sac* extending up the back of the innominate and lower part of the carotid.

CHAPTER VI.

ANEURISMS OF THE AORTIC ARCH.

We now have arrived at a part of our subject which involves the most modern developments of surgery, namely, the benefits which in carefully selected cases of thoracic aortic aneurism may accrue from tying certain vessels in the neck. The idea dates only from 1869, in which year Dr. Cockle read a paper at the Medical Society of London, afterwards published.[1] In this paper Dr. Cockle pointed to a number of cases in which aneurisms of the transverse part of the arch had become entirely or partly obliterated by occlusion of the left common carotid. In some the occlusion was fortuitous, at least not brought about by art; in others it was the result of deligation under mistaken diagnosis. He recommended in certain cases deligation of that vessel; following out this idea, several such operations have been performed, viz., by Mr. Heath, Mr. Holmes, and myself with incontestable benefit.

[1] *Lancet*, vol. i. 1869, pp. 422 and 489.

Careful consideration of this whole subject led me several years ago to believe that our view of the subject should be extended in a direction which I can best indicate by transcribing almost verbatim my paper published in the *Med.-Chir. Transactions*, vol. lxii. p. 393 *et seq.*

In considering certain facts concerning the aortic arch and its blood-stream, I came to the conclusion that distinctions must be drawn as to the operative treatment of aneurisms occupying different portions of that trunk.

Let me call attention to the mode of origin of the three great vessels, which has not, I think, attracted any attention. First, we see the great brachio-cephalic trunk; then, be it observed, there is no interval between that and the left carotid. There is not, as is usually figured and imagined, between these two vessels a bit of transverse aorta, convex upward, but a mere angle; a sort of V-shaped double septum; a rather wider angle separates the left subclavian from the carotid. If the lower part of the ascending aorta be severed from the rest, and we look along the tube of the transverse part, we do not see the orifices of the carotid and subclavian fore-shortened into an oval or mere slit, as would be the case if these vessels were given off straight and plumb from the parent stem. On the contrary, these openings face us directly we seem to see right into

the lumen of each branch, chiefly into the carotid.[1] This results from the mode of origin of those vessels. They are not given off straight and rectangular from the transverse aorta, but their roots take a very oblique direction to the left, and then swerve more directly upwards, hence the distal margin of each vessel lies on a level considerably lower than the proximal. Each such margin has running from it downward and to the right, on each side wall of the aorta, a rounded ridge, so arranged that the projection of the distal lip and twofold spur—in shape not unlike a half-funnel—catches the blood-stream as it courses along the main trunk, and directs each its own share into its special branch. The arrangement of these ridges is such that they divide all the upper aspect and a considerable part of the side wall of the aorta into districts, one for each vessel. Hence an aneurism, unless it spring from the inferior, the concave wall of the arch, must almost of necessity belong to the district either of one branch

[1] In the paper above referred to, I, being anxious to accentuate the absence of foreshortening, said, "These openings look nearly round." The expression was infelicitous. Every careful anatomist knows that the openings are not round; their shape is different in different individuals. The general condition is that the innominate and subclavian openings are nearly semicircles, having their flat sides opposed at a considerable angle to each other, so that they are more widely separated in front than behind. In the wider part of this interval, and generally anterior to both the other orifices, is the opening of the left carotid, rhomboid in shape, the short end behind, so as to fit the interval above described pretty accurately.

or of the other. Furthermore, there is no room on the upper surface of the arch between the innominate

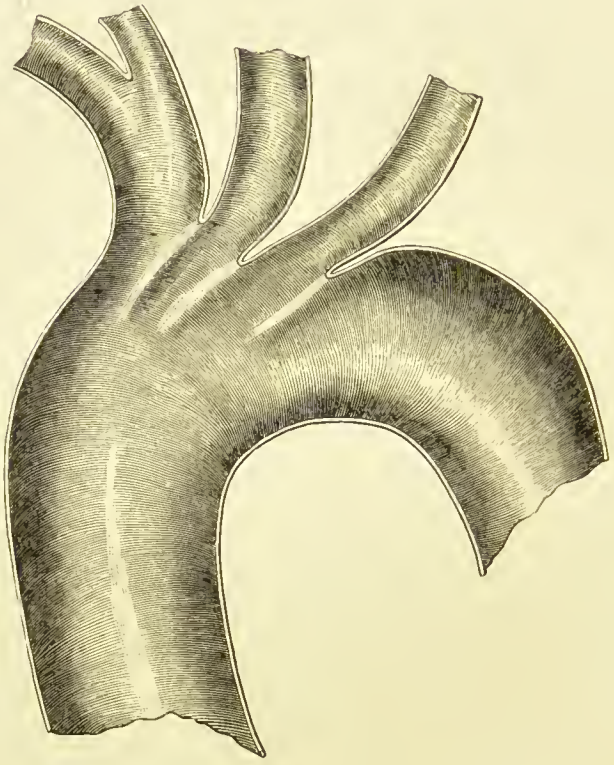

FIG. 8.—Arch of aorta and large branches, showing the oblique roots of the great vessels and the ridges running from the orifice on the aortic walls.

and left carotid, for an aortic aneurism; such a tumor must belong to one or the other branch.

Now to another consideration. When a concretion is detached from an aortic valve, it almost invariably passes into the left carotid, sometimes into the left

subclavian; into the right carotid artery only about once in twenty-five cases. This circumstance has given rise to the assumption that the left carotid lies, more fully than the right, in the axis of the heart and ascending aorta. The very reverse is the fact. If a little hole be made in each carotid just below its bifurcation, and a probe be passed along the common trunk as far as it will go without the use of any force, if then the front wall of the chest, &c., be removed and the ascending aorta carefully opened, the two probes will be found crossing within the vessel. The right one will be seen to pass through the aortic opening not far from its left margin, and to be well within the ventricle; the left one strikes the tendonous ring of the aortic orifice on the right aspect of the vessel. In most bodies the end of the instrument will be just within the heart, in others it will be in the sinus of Valsalva. The probe is never in the axis of the aorta, but strikes the wall, be it of vessel or of ventricle, at a considerable angle.

We must therefore attribute this tendency of detached concretions to some cause truer than that erroneous anatomical conjecture.

Solids within a stream, if not too heavy, go with the strongest current; therefore it would seem that some subtle curve or slope of the internal surface of the aorta directs the most potent rush of the stream somewhat obliquely across the ascending part of the

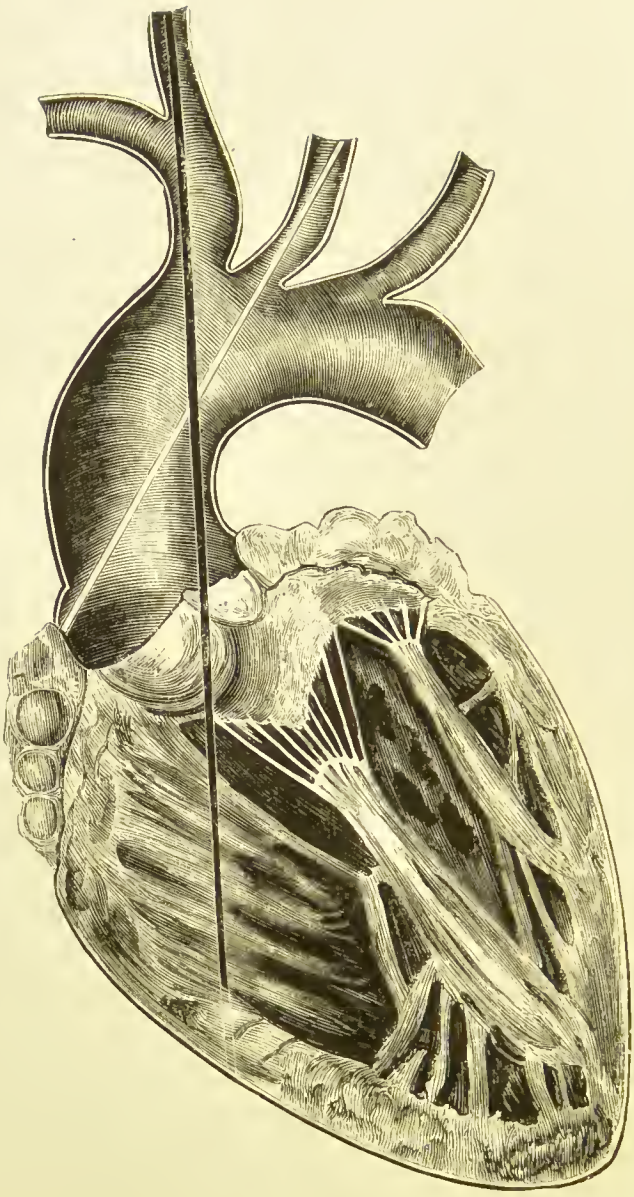

Fig. 9.—Axes of Heart, Aorta and Carotids.

vessel towards the left carotid. The axis of the left ventricle is not in a line with that of the first part of the aorta, but, if prolonged from the apex through the centre of the orifice, falls upon and about the outer sinus of Valsalva, whose concavity appears well calculated to divert the blood-stream in the direction indicated. In this course the current would pass from the right aspect of the aortic obliquely towards the carotid orifice; it would occupy that portion of the trunk which on the diagram lies to the left of the whole probe (Fig. 9). Possibly the potent flow of blood in this direction is associated with the preponderance of the left brain and of the right half of the body.

Now if this be the more rapid part of the current, it follows that outside it and to its right there must be a slower stream, and it is easily comprehensible that, if the left carotid be occluded, the force of the rapid stream must be diverted to the right, whereby the more placid stream would be rendered quicker and stronger. Hence it would appear that, if aortic aneurisms are to be treated by deligation (and I shall presently show that in many cases much may thus be gained), we must distinguish between those that arise from one or the other portion of the aorta. Of course in many instances such diagnosis is difficult, in others it is impossible, because the disease involves so large a portion of the vessel that no such distinctions exist. In such cases, I, trusting

to present experience, should not feel disposed to recommend any such operation.

If it be said that all this about varying aortic currents is mere theory, I reply that there are no means whereby the presence or absence of such differences can be demonstrated save the experiences with which we are supplied by nature. Even if we could make the chest-wall and the aorta transparent, we could only see the sort of stream by throwing in floating bits of matter. Pathological facts, such as we have here in the left-sided destination of fibrinous concreta, are among the most conclusive of physiological experiments.

Nevertheless, mere theory offers no sufficiently solid ground for the foundation of an operation of this magnitude unless supported by some facts in practice. In the Museum of the College of Surgeons (Pathological Series, No. 1596 A) is a dissected specimen taken from the woman on whom, in 1865, Mr. Heath performed deligation of the right carotid and subclavian for supposed aortic aneurism. A diagnosis which, in spite of all skill and care turned out to be erroneous, renders this case most valuable for my purpose. The aneurism purely aortic occupies just that part of the ascending arch which lies in Fig. 9 to the right of the white probe. The aneurism, however, became consolidated, and, in spite of the most wretched drunken habits, the woman lived for more than four years. Again

Laura G., on whom I performed double distal ligature, was cured of an aorto-innominate aneurism (see Case X.), while J. S. was also, I believe, cured.

Thus the cases quoted by Dr. Cockle and those which, following his views, have since been subjected to operation show that benefit can, in certain instances, be obtained by occlusion of the left carotid artery; while the views here set forth, and certain cases, show that aneurism of the aortic arch somewhat differently placed may be cured by tying the vessels given off by the innominate. There remains then to discriminate (1) cases which may be cured or greatly benefited by tying one of the vessels of the neck; (2) cases in which the right carotid and subclavian; (3) cases in which the left carotid should be tied.

The subject is of immense importance and interest, for, to be able to prolong life very considerably, and to render that additional period free from suffering, must ever be the great aim of our profession. But also—and this can never be too strongly stated—we must be able to effect this not merely for a few of the patients treated at the expense of others subjected to operation without benefit or with injury; there must be in every case no fortuitous element, but a clearly formulated and high probability of advantages to be gained. But to attain to selection of cases, some difficult and minute problems in diagnosis have in every instance to be solved; nor

can I pretend in an essay like the present to do more than give a brief outline of the principles which it appears to me should chiefly guide us.

The only forms of aortic aneurism with which surgery can cope are the sacculated and such dilatations as occupy but a very limited and defined portion of the trunk. The former is more favourable than the latter form of disease. Fusiform enlargements, occupying a considerable length of the vessel, are not amenable to surgical treatment; nor indeed would I operate upon any case, whose symptoms did not permit of fairly clear and distinct definition of the place whence the aneurism might arise. This diagnosis is as yet not fully developed. Till of late years, when once an aortic aneurism had been diagnosed, enough appeared to have been done; even now all medical men may not care to discriminate between tumors which spring from one, and those which arise from another part of the arch.

There may, therefore, be some symptoms whose significance has not been clearly made out; unless, too, I be mistaken, the not very distant future will detect a meaning in certain combinations, which are not as yet fully estimated, and thus may eliminate one or two ambiguities and difficulties in our means of judgment. This will be the more facile in such cases as have been scientifically watched from their early commencement.

A sacculated or unilateral dilation has inherent in

it a tendency to increase in two directions, namely, immediately away from the walls of the vessel, and onward in the course of the circulation. These combined impel the growth in an oblique line compounded of the two forces. The direction is, however, considerably modified by the consistence of the parts against which the tumor impinges; for instance, loose areolar tissue allows much liberty of, while ligaments or strong fasciæ oppose great barriers to growth. Bone, although it becomes absorbed by the pressure of an aneurism, retards increase in that direction for a considerable time, more especially at first; it is the periosteum and outer face of the bone which offers most determined resistance; when this part has yielded, absorption is far more rapid. The earliest symptoms, therefore, if they have been scientifically watched, are of great value in facilitating the localisation of the disease; the later ones, giving more complicated signs, are often very difficult, unless the commencing phenomena furnish a key to their interpretation.

These points being premised, we may go on to consider the symptoms produced by aneurism of the aortic arch generally, and at first without reference to the order of their appearance.

1. Tumor, pulsation, dulness, and certain sounds depend upon the growth of an aneurismal sac from the artery merging towards the surface, displacing resonant lung by non-resonant blood (fluid or solidified).

When the aneurism comes within a certain distance of the surface, the chest-wall protrudes, firstly by mere bulging, afterwards by a conical tumor, which visibly and sensibly pulsates. Around the point of strongest pulsation a space of gradually diminishing impulse is traceable; so, too, dulness is in the middle of the space absolute, further out relative only, diminishing more and more until it merges into resonant parts; the dull area is usually continuous on one of its margins with cardiac dulness. Over the pulsatile enlargement the heart-sounds are heard with abnormal loudness, but the second sound much more accentuated than the first; it is sometimes a dull, heavy thud, in other cases is a sharp metallic ring, but is always loud in proportion to the first sound, even louder than over the heart itself. *Bruits* have hardly been mentioned hitherto, because their presence or absence is so variable; they are of different qualities and degrees, from a mere coo to a harsh saw-like noise. Many cases run their whole course without any such abnormal sound; others are accompanied throughout by *bruits;* while in still a third series the murmur —blowing or rasping—may be heard, either at the first or last part of the case, while the rest is silence. These sounds then, when present, are valuable symptoms; their absence does not negative the existence of aneurism. We will class this whole range of phenomena under the term tumor symptoms.

2. Changes of the pulse are important, and are of different sorts. An artery may be partially obstructed by an aneurism springing from another vessel, curling over and pressing on its trunk; or indeed by a non-aneurismal tumor. Such ambiguity must be cleared away by examination of other symptoms. The direct influence of an aneurism on the pulse of the vessel from which it springs is a reduction of the beat of the vessel; it does not necessarily follow (though usually it is the case) that less blood finds its way along the tube, but it does so in a more even manner, and not per saltum. A familiar, though not perfectly accurate, simile might be taken from the mechanism of a fire-engine (the heart), which delivers water along the hose (artery) in an even stream, although its force is by alternate strokes of the pump. This is effected by letting the tube first pass into a cavity, kettle I believe it is called, from which the hose issues. Now the kettle contains at the top a little air, whose elasticity, acting as a spring, mitigates or, in fact, eliminates the intermittent or pulsatile quality of the current. The aneurism has in it no air, but the widening of the channel at a point between the heart and the artery examined is sufficient to mitigate, not altogether suppress, the pulsatile character of the stream.

Thus the sphygmographic trace shows a sloping upstroke and absence of tidal and dicrotic waves, so

that, for instance, in an aneurism of the innominate or either subclavian the line may represent a mere succession of even and shallow undulations. This is represented to the finger by a weak, full, soft pulse; *i.e.* by an artery which throbs slightly, never empties itself, and, not having the stimulus of the expansile throb, contracts but slightly. An aneurism situated less directly on the course of the artery examined causes changes less easily described, because more varied, a less sloping upstroke, and all beyond represented by a zigzag line running down to the next upstroke; this to the finger is a weak pulse, with a thrill or vibration, and so on.

3. Dyspnœa and other respiratory troubles are among the most distressing symptoms of aneurism at the upper part of the chest and root of the neck; indeed many cases of the disease prove fatal merely by obstruction to the breath. The troubles are of two kinds, produced, the one by direct pressure on the trachea, bronchi, or both, the other by interference with the recurrent laryngeal nerve. Nor are these difficult to distinguish from each other. The first produces dyspnœa from absolute obstruction, more, as my friend Dr. Irvine has pointed out, to expiration than to inspiration. This is constant, *i.e.* the breath is never free, but every now and then there arise severe paroxysms of violent efforts for breath; the chest heaves, the veins of the upper part of the body swell, the face becomes livid, a little air wheezes in

and out, severe brassy cough adds to the distress until a little thick mucus is expectorated. The quieter phase is then restored until another slimy piece of secretion obstructs the already too narrow channel. With all this the voice, unless in the exacerbation, is not particularly weakened, nay, sometimes it is rather loud and metallic. The other trouble commences with changes in the voice, first of all in the tone, which is high, squeaky, and false, or whispering with muffled falsetto. If dyspnœa occur at all, it does so early in the case, the symptoms resembling laryngismus stridulus.[1] It is under such circumstances also paroxysmal, but less frequent and more periodical than the formerly described breath trouble. After an interval, aphonia sometimes complete sets in, and there may be considerable tendency to choking at meals, *i.e.* to the food passing into the wind-pipe. Examination with the laryngoscope will show that the former condition depends upon tightness (spasm) of one vocal cord, rarely of both, the latter on paralysis. In some cases the dyspnœa and violent cough (tracheal or bronchial symptoms) coexist with the laryngeal troubles.

4. Dysphagia from pressure on the œsophagus is nearly always a later sign than tracheal or bronchial dyspnœa. The patient finds a difficulty in swallowing, first solids and afterwards even liquids. By

[1] Sir Thomas Watson says that tracheotomy has been more than once performed in this disease, mistaken for laryngitis.

listening a little on the left side of the last cervical or upper dorsal vertebræ while the patient is swallowing a teaspoonful of water, a prolonged reduplicated effort will generally detect, even before the patient is himself aware of it, obstruction in the gullet.

5. One of the most important symptoms is produced by pressure on the veins, causing congestion of different parts, often a doughy lump over either or both clavicles, œdema about the face or arms. The significance of the localities affected will appear in the sequel.

6. Irregularity of the pupils, either dilatation or contraction from irritation, and then destroyed function of the sympathetic, perhaps also of the vagus.

7. Displacement of the heart downward and to the left, and certain pains in the depths and at the back of the chest, afford valuable though somewhat negative data.

Certain combinations of the above signs are, however, remarkably positive, I had almost said infallible. For instance : pressure wholly and entirely on the right bronchus (see Case X.). Congestion of both arms and both sides of the head and chest with tumor symptoms, chiefly about the second space and rib, considerably to the right of the sternum ; heart displacement, if any, directly outward ; the pulses equal very slight sphygmographic change, perhaps a rather sloping upstroke, usually a flat, blunt apex, absence

partial or total of dicrotic wave, but whole down-line undulatory; both indicating disease of ascending aorta, the former behind, the latter in front, and to the outer side. Congestion of the left arm, and on the left side of the head; right pulse (radial and carotid) aneurismal; tumor symptoms a little to right of the sternum; probably some tracheal dyspnœa, are symptomatic of aorto-innominate aneurism. Affection of left radial pulse, left vocal cord, left venous congestion with tracheal dyspnœa and obstruction of air to both lungs, tumor symptoms on and to the left of median line mark disease of the transverse aorta. Air obstruction to the left lung alone with pains at the back and along intercostals are indicative of disease of the third part of the arch.

It is unnecessary probably to multiply these examples, which must be taken as the simpler, broader lines of diagnosis. We shall shortly have occasion to return to some of the conditions to be found in aortic aneurism.

CHAPTER VII.

TREATMENT OF ANEURISMS OF THE AORTIC ARCH.

No one would, I presume, think of subjecting an aortic aneurism to operation unless medical treatment, being fairly and fully tried, had failed to check or modify the growth of the tumor. The grand essential of this treatment is to keep the action of the heart and vessels as quiet as possible; the next to feed, and if desirable also to medicate, the patient in such manner that his blood shall be in a state in which coagulation is possible, or even probable. For the first indication the patient must be kept in bed, and as still as he can possibly lie. His diet should, if he be plethoric, at first be low, consisting of milk, breadstuffs, butter, rice, or other farinacea, with an egg or fish should hunger be complained of. In two or three days, when the too sthenic symptoms are somewhat subdued, a dry diet is preferable, and I consider some meat adds to the probable coagulability of the blood; for instance, some of my patients have done well on—for breakfast and supper, bread 4 oz.,

butter ½ oz., milk 4 oz.; dinner, meat 4 oz., bread 3 oz., water or milk 4 oz.; a little fish or an egg may, if necessary, be added to the morning meal. If discomfort arise from thirst, a limited quantity of ice to suck, or sulphuric acid and a very little sugar may be added to the water. Sometimes from two to five drops of ipecacuanha wine every four hours relieves thirst more than anything else, but it sometimes fails. I have given on theoretical grounds the perchloride of iron, I think with advantage. Of course, if coagulation take place while a patient under rest and diet is also taking iron, it is difficult to say what part in so slow a process the medicine may play.

Of medicines to quiet the heart's action, digitalis and atropia are the most reliable.[1] The former is best given in infusion, commencing in two-drachm doses; its diuretic effect may also be valuable, since by causing excretion of water it would tend to leave the solid parts of the blood in some excess. But belladonna is more valuable, inasmuch as it soothes pain and respiratory troubles, while it stills the heart. I generally, if the tumor cause local pain, apply over it a piece of lint, thickly spread, almost soaked in equal parts of extract of belladonna and glycerine, covered with thin mackintosh. This is, probably because it is more easily absorbed, more

[1] Theory would cause us to look upon aconite as also likely to promote this object, but I have not tried the drug in aneurism.

efficacious than the extract alone. I also give internally, as occasion may serve, atropia. Of this, the best formula is one that was devised by our late excellent resident officer, Mr. Wickers, viz. the liquor atropiæ salicylatis, made thus:—

Take of Atropia ...	...	...	gr. v.
Salicylic acid	...	...	gr. vii.ss.
Hot water	...	...	℥ x.

Rub down first the atropia into a very fine powder, then little by little the salicylic acid with it. Add slowly 10 oz. of hot water. The whole must dissolve, and the solution must measure or be filled up to 10 oz.

The dose is ten minims—that is $\frac{1}{100}$ grain of atropia. I have on one occasion increased it up to fifteen minims. The preparation is more certain and uniform than any other with which I am acquainted.

In Iodide of potassium I not only have no faith, but believe it often to be positively injurious. The drug is usually administered under the idea that the atheroma giving rise to aneurism is of syphilitic origin. Now, certainly many syphilitic persons have atheromatous arteries; but it is equally certain that many people with the same vascular condition are not syphilitic, while a great number who have suffered from the *lues* have also had acute rheumatism, and a still greater number are the

subject of alcoholism; and these conditions seem, according to my experience, quite as frequent forerunners of aneurism as syphilis.[1] But even if one had the faith that atheroma is invariably or in the majority of instances a specific gumma, yet it only acts in aneurism by having mechanically weakened the vessel, we cannot cure the aneurism by treating the tendency to form gummata.

Iodide of potass is most useful in those inflammations, which tend to fibrous thickening or deposit, in periostitis, rheumatic enlargements, &c., in fact in maladies where a tendency to fibrillation is strongly marked. It acts by diminishing the fibrine of the blood, or by preventing its tendency to solidify. But it is this tendency which we especially want for the cure of aneurism. Perhaps if we knew that atheromatous degeneration were commencing, or were imminent, we might prevent or retard such action by free administration of the drug; but when, on account of such deterioration, mechanical dilation and giving way of the vessel have occurred, an antisyphilitic remedy as such cannot be useful. If it could be shown that iodide of potass tends to

[1] The records of military surgery tend to show that aortic aneurism is closely connected with syphilitic infection. An excellent paper by Mr. Welch (*Med. Chir. Trans.* vol. lix. p. 70) would seem greatly to confirm this idea. Thus of thirty-four cases of aortic aneurism, one-half occurred in syphilitic soldiers, but these numbers are of little value unless we know what proportion of the regiments from which these men came where syphilitic.

promote coagulation, there would be some intelligible grounds for its administration.

Nevertheless—and this circumstance, has, I believe, given rise to an unfounded belief in the curative properties of the drug—Iodide of potassium does, under certain circumstances, undoubtedly relieve a species of pain which arises during the progress of some aneurisms. As far as my observations go, it seems that these peculiar pains are those that are produced by pressure on periosteum and bones, for while bone-absorption is in progress and much aching chiefly at night is complained of, the drug proves an anodyne. Another form of pain, neuralgic in character, and running from the tumor in the course of nervous trunks, is better treated by the Bromide of potassium.

A certain number of people with thoracic aneurism have undoubtedly got well under medical treatment. The cases, however, are but few; the great majority, though benefited for a time by rest (see p. 43), though even the attendant may hope his patient will recover, begin, after a while, to show signs of continued increase of the tumor. Hence every such case should be sedulously watched, in order that failure of the treatment may early be recognised, and, if the conditions be suitable, more potent measures adopted. Especially should the commencement of pressure on the trachea or either (chiefly the right) bronchus be jealously noted, because

increasing dyspnœa is not only a sign that the tumor is increasing, but is also evidence that treatment by rest is no longer possible. Yet one often sees patients lying or sitting up in bed, shaken now and again with violent cough, leading to the verge of suffocation, even in the intervals gasping for breath, while yet the hallucination is entertained that he is undergoing treatment by rest. What chance can there be of rest while all the respiratory muscles are labouring harder than blacksmith ever worked? The chest is trying to enlarge, while, as the lung is unable to expand, the force of the inspiratory muscles is expended in filling the aneurism, the heart meanwhile beating with terrific violence and frequency.

Another reason why tracheal or bronchial obstruction must not be allowed to continue, if it can possibly be checked, is the pulmonary changes which it produces, changes that would kill the patient even if we cured the aneurism. This fact, and the pathological condition, was first pointed out by my friend, Dr. J. Pearson Irvine, whose words I cannot do better than quote:—

"The left lung, whose bronchus was compressed from behind, was not diminished in size, was hard and solid to the touch, and in removing it the apex broke down, thus revealing 'cribriform cavities' containing vast quantities of puruloid matter. With these the bronchi were loaded; their calibre was

irregular, dilatations of very nondescript character occurring frequently, and indeed in many places dilated bronchi seemed to be a part or the whole of the cavities mentioned. Where the bronchial walls were more perfect the mucous membrane was deeply congested or stained by recent extravasations or by the pigmentary matter of older extravasations. The lower lobe of the left lung was also very solid and firm, and its cut surfaces, while in part cribriform, as in the upper lobe, were mostly uniform of a red greyish colour, across which whiter bands ran as a network. In some places nodular masses, yellow and hard, having the appearance of being distinctly circumscribed, were found. In this lobe existed also an abcess-like cavity, the size of a pigeon's egg, filled with yellow pus, and surrounded by a distinctly fibrous wall, from which passed various intersecting bands across the cavity. The pleura was in many places immensely thickened, and at the base of the lung it cut almost like cartilage; the two lobes had become united by a pleural hypertrophy of similar nature. The puruloid contents of the lung varied in colour and consistence, but their chief constituent microscopically were pus-cells."

How changes actually arise where there is pressure at the root of the root has been a matter of dispute, but from the case I show it is evident that simple compression of a bronchus may lead to vast pulmonary disintegration. Gradual consolidation of the lung

is the result of such compression; secretions must accumulate in the large and then in the small bronchial tubes, because their exit is impeded by the gradual increasing constriction of their main outlet.[1] There follows in consequence imperfect circulation, and thus we get all the conditions, which favour such extensive lung changes as those of lobular and interstitial pneumonia. It is likely that accumulated secretions acted backwardly on the air-cells of the lungs, and thus on the interstitial tissues. A chronic train of phenomena must have been set up, "resulting in the changes above described, and which have been shown less advanced by Drs. Peacock and Ogle."[2] The careful observer then goes on to show that the changes are not caused by pressure on the nerves and vessels, which could not in the case described have been compressed, indeed in all cases must be protected by the greater resistent power, "less flexibility," of the bronchus.

Here too may well be made a further remark. No mode of death is so terrific, so full of prolonged agony, as that by slow suffocation through gradual closure of the trachea. The livid face, the struggling, gasping form, bathed in clammy sweat, the violent pain of the tired, throbbing chest constitute altogether a horrible combination of suffering.

[1] Emphysema is, perhaps, the first consequence of gradual compression.

[2] *Pathological Transactions*, vol. xxviii. p. 67.

One would indeed make all reasonable efforts for the alleviation of such torment, even though the disease might not be permanently cured. Now in all cases on which I have operated by tying one or the other vessel of the neck, even in those which have not got well, life has been rendered easy, and at the same time greatly prolonged.

We must, however, have a clear guidance as to which cases will, and which will not, benefit by such treatment. For this cause the symptoms of different aneurisms have been as above somewhat minutely considered. Furthermore, we have to discriminate between the suitability of two operations, namely, on the left and on the right side of the neck. In order, therefore, to save space and my reader's time, I will put in tabular form the conditions which should guide us in this threefold choice. It must of course be understood that principles only, not the minuter points, can be thus tabulated, that in the combinations certain of the symptoms may, especially if early in the case, be wanting.

FOR DELIGATION OF LEFT CAROTID.

Tumor symptoms on the left of the mesial line with left venous congestion, alteration of left radial and carotid pulse, paralysis of left vocal cord, obstruction of air equal on both sides, sometimes alteration of left pupil.

FOR DELIGATION OF THE RIGHT CAROTID AND SUBCLAVIAN.

Tumor symptoms on the right of median line. Marked changes in the right radial and carotid pulse. Venous congestion on the right side affecting firstly and chiefly head and neck. Afterwards, with increase of tumor, right arm and chest and right vocal cord may be paralysed.

Tumor symptoms on the right of and upon the mesial line, running up to sterno-clavicular joint and episternal notch, venous congestion on *left* side, alteration of right pulse (radial and carotid), tracheal dyspnœa.

Tumor further to the right and lower (second space), congestion equal on both sides, no marked difference between the two pulses; heart displacement, chiefly outward.

Pressure on right bronchus, left lung perfectly free, with puerile respiration, perhaps emphysema.

With any of these conditions changes of the right pupil may be combined.

DOUBTFUL SIGNS ONLY TO BE READ BY THE LIGHT OF OTHERS.

Venous congestion on the left side; tracheal dyspnœa; dysphagia.

Operation should be avoided.—When tumor symptoms reach widely on both sides of the mesial line. When, with paralysis of left vocal cord, there is obstruction of right bronchus. When locomotive pulse, thrill, and double murmur show considerable aortic incompetence. When there is mitral disease. Considerable cardiac hypertrophy. When there is, in the course of the aorta, the rasping sound of calcification or advanced atheroma, more particularly if one may feel superficial vessels to be rough and rigid. When there is pain about the spine and intercostal nerves; when there is obstruction of left bronchus only; when there is pressure on left apex, and expectoration of frothy blood. To these positive signs, I would add a negative one, viz. such indefinite symptoms as would render any diagnosis as to the site of the aneurism doubtful.

In firstly considering obstruction of the left carotid by deligation or otherwise, I would refer to Dr. Cockle's paper, already noticed, and two cases published by Mr. Heath and Mr. Holmes,[1] and would add the following:—

Case IX.—George A., aged fifty-six, was under Dr. Silver's care in 1877 with aneurism of the transverse aorta. There was pulsation, but no bulging of the chest-wall. Deep behind the left clavicle, just

[1] *Clinical Society's Transactions*, vol. v. p. 183, and vol. x. pp. 96–7. Mr. Holmes' patient is, I believe, still alive and in service; Mr. Heath's suffered relapse after four years of hard work and died.

outside its sternal joint, pulsation could be felt. The man suffered from occasional fits of dyspnœa, and such attacks of coughing as amounted almost to strangulation. The left vocal cord was paralysed. The left pulse was very small and weak, the right one normally strong. In consultation, Dr. Silver and I agreed that, unless some decided step were taken, the man would probably not survive a week, and that his sufferings, already severe, would go on increasing to the end. The man was very anxious that something should be done, although told that an operation could not cure, but would probably relieve him and prolong his life.

November 17th.—I tied the left common carotid. No bad symptoms followed; the wound healed in eight days. Almost from the moment of operation the dyspnœa and cough diminished, and in ten days ceased altogether. The man could lie down; he slept and ate well, and lived for four months, dying ultimately of the kidney and liver disease, with which he also was affected.

Of deligation of the right vessels, I would first give the case of aorto-innominate aneurism already published in the *Med.-Chir. Transactions*, only premising that the condition of this patient, and the large participation of the aorta in the disease, is one of the points on which I would strongly insist for proof of my views that in certain aneurisms already defined, the practice inculcated is beneficial and life-saving.

CASE X.—Laura G., aged thirty-seven, admitted into Charing Cross Hospital, under my care, 20th November, 1877, with aneurism at the right root of the neck and upper part of the right chest. Her parental history is bad (phthisical). After some overwork, she, in September, 1876, found her breathing difficult, soon after had sharp indefinite pains about the upper part of the chest and right shoulder. She first noticed enlargement above the breast about eight months ago. During the two months previous to her admission the tumor had markedly increased.

On examining her I found a projecting tumor, with broad base and rounded apex, between the lower edge of the second costal cartilage and the sterno-clavicular joint. It protruded above the episternal notch, and pressed forward the right sterno-mastoid muscle. Its inner or left margin covered the right part of the sternum to the extent of one-third of its breadth. It measured transversely one inch and three quarters; its lower edge was two and a-half inches below the sterno-clavicular joint, but just below this articulation a small portion of the chest-wall seemed free of tumefaction. This tumor pulsated visibly; to the touch the pulsation was markedly expansile, and for a certain distance round the apex the impulse seemed very near the surface. Pulsation could also be felt through the chest-walls for a considerable distance round the tumor, viz. on the left clavicle, for about an inch on the right,

for an inch and a-half from its inner end. Above the sternum, about an inch and a-quarter, reaching under the edge of the left and to the outer margin of the right sterno-mastoid muscle, the rounded margin of a pulsatile tumor could be felt.

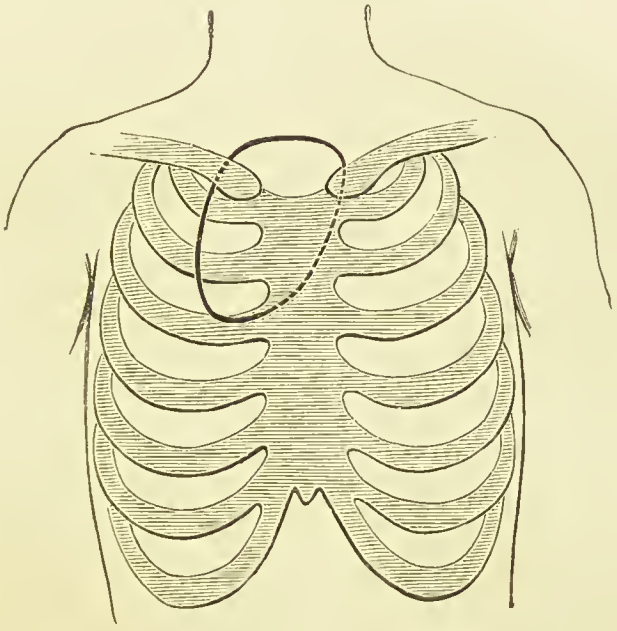

Fig. 10.—L. G., Area of Pulsation.

Dulness to percussion mingled on the left side of this space with the cardiac dulness, but on the right was more extensive than the pulsation, as though the lung covered that portion of the aneurism. Over this whole area the heart-sounds were loud, with a metallic ring, but the second sound is more especially

remarkable as being louder than the first, and having a peculiar dull yet metallic note.

The veins of the left arm and those on the chest below the left clavicle were very plainly marked.

Sphygmographic tracings were taken by my friend, Mr. Wickers.

The sloping upstroke of the right one is the chief difference, the downstroke in both is undulating, and shows low tension.

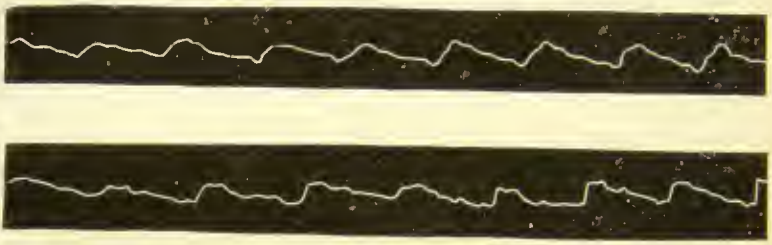

Fig. 11.—Sphygmographic Trace.

The patient was treated by diet and rest, but the tumor increased slightly, its apex seemed approaching still nearer to the surface; therefore, on the *6th December*, I tied the carotid and subclavian (third part) arteries.

10th.—She suffered the night after the operation from headache, not limited to the right side—evidently the result of narcosis. On the third day, the *8th*, the pulsation seemed more distant. At the above date the tumor had diminished in size, and its beat was more distant and weaker—her right arm felt rather numb.

14*th*.—The carotid wound was healed and skinned over. The most projecting part of the tumor, as also that portion in the episternal notch, appeared solid. It was also smaller, measuring an inch and an eighth in the transverse, and two inches in the perpendicular direction. Her cough had almost ceased.

22*nd*.—Still uninterrupted decrease of the tumor without a bad symptom—no radial pulse has as yet been felt. On the seventh day of the operation the temperature became normal; it was still taken

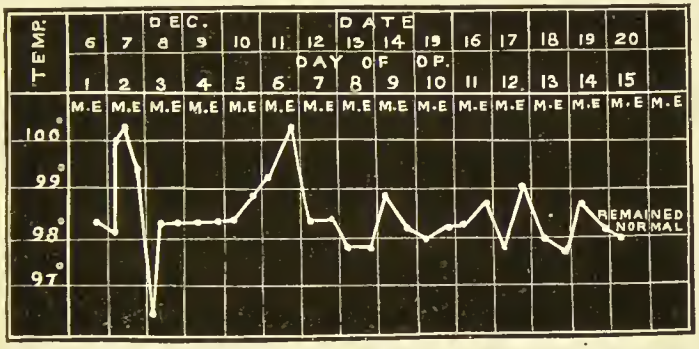

Fig. 12.—Temperature Chart.

for a week, and then the observations were discontinued as being useless. There was barely any pulsation in the episternal notch.

March 2*nd*.—On the night of the 1st there had been brought into the ward a woman horribly burnt, under distressful circumstances. The occurrence greatly agitated Laura G., and for some days pulsation about the remains of the tumor became more violent. As, however, her heart and all arteries beat

during that time with excessive power, it appeared probable that the additional throb was merely communicated.

23*rd.*—The tumor on a level with the chest-walls.

May 20*th.*—Occasionally—as, for instance, during menstrual periods—though the chest-wall where the tumor previously existed was flat, additional pulsation occurred. At these times local applications of ice are employed.

August 26*th.*—The excitability of the vascular system has caused me to prolong this patient's stay longer than was perhaps necessary—she left at the above date. The following remarks are from the Case-book :—

"There is a part of the chest-wall roughly corresponding to the dimensions given in the first description of the case, which, although it looks normal or nearly normal, may be felt to be beneath the skin more protuberant than the same part on the other side—it is quite hard. A distant not expansile pulsation (communicated) can here be felt. A little below the sterno-clavicular joint a small part, about an inch in diameter, is dull to percussion, the rest fairly clear."

The radial pulse was entirely absent for four months after the operation; then an occasional flicker was perceptible, and when she left a weak, small, but constant pulse was perceptible.

November 7th.—This patient, perfectly well, was exhibited to the Fellows of the Medico-Chirurgical Society.

In the middle of February, 1879, I heard that she was married. In March I examined her, and found the signs of solid tumor in the front part of the chest diminished in size; she said she was better than she ever remembered being, had no cough, nor shortness of breath.

May 9th.—Under her married name, Laura G. came to the hospital suffering from a severe attack of bronchitis. She expectorated a considerable quantity of mucus at first, slightly streaked with blood. Under careful treatment she recovered in three weeks sufficiently to get about. On the 28th her husband insisted on her going out, although warned that the lungs were in a very critical condition. It is to be observed that, although the mucous *râles* and minute crepitation of bronchitis were strongly marked, and the cough frequent, there was no sign of pressure anywhere; the tumor did not increase, its pulsation remaining merely communicated. The cough, though frequent, was not paroxysmal; and though breathing was, as in severe bronchitis, difficult, there were no fits of dyspnœa.

Rather more than a fortnight after she had thus quitted the hospital, we learned that she had under-

gone much exposure to very unseasonable weather and was again very ill with bronchitis—shortly afterwards, that she was dead. This last information only reached the hospital some days after the event, so that some time elapsed between her death and the *post-mortem examination.* The aneurism—heart and large vessels—were removed from the body, which was somewhat decomposed, without further examination. In lifting the anterior thoracic parietes, the aneurism, of which they formed the anterior wall, was necessarily implicated; and in this stage nothing further was made out concerning the condition of parts, except that the tumor entirely consisted of solid clot. The lungs were congested, and in great part solidified—the bronchi intensely injected. In the state of the body further investigation did not appear advisable.

The parts removed, being sufficiently hardened in spirit, were examined by myself and Mr. Cantlie. The aneurism, the most anterior part of the preparation, had no front wall; it consisted entirely of firm blood-clot, surrounded by dilated arterial coats. It measured two and a-half inches in the perpendicular, and a little over two inches in the transverse direction. It sprung from the anterior aspect of the ascending aorta, just by the first bend, and from the root of the innominate. But the orifice of the sac was difficult to define, since a smooth membrane covered the clot along the course of the vessels. The

lumen of the aorta appeared a little altered by backward pressure.[1] The right carotid artery was occluded; the subclavian patent, as far as removed, but small. The innominate also seemed much diminished in size.

The left innominate vein, passing in front of the tumor, was unaltered in size, but was deflected a little forward by the rounded projection of the blood-clot—its coats seemed a little thickened, probably from previous pressure. The trachea was displaced somewhat to the right; but with this exception there was hardly any change from the normal position of parts.

Fate, combined with imprudence and obstinacy on the part of my patients, had thus given me the fortunate opportunity of verifying the cure of two aneurisms after deligation. The benefit to or the cure of such disease arising not at all from the innominate, but from parts of the aorta already specified, is exemplified by the following case. The opportunity was afforded me, by the kindness of Dr. Green, in the person of

John S., aged 36, who had been admitted into Charing Cross Hospital under that gentleman's care on the 9th January, 1879. The man looked older than his stated age, his scalp hair being quite

[1] It looked a little flattened, but since the parts had lain several months in spirit, it was impossible to say how much of this was due to their position in the jar.

grey. His father had died of heart disease. There was no history or appearance of syphilis nor of rheumatism. From the time of his admission he had been treated by the best means known to medicine, yet the tumor continued to increase, as evidenced by his somewhat unusual symptoms.

February 8th.—I saw him in consultation with Dr. Green. On the right side of the upper part of the chest I found strong heaving pulsation, extending over a considerable space, but not limited by any clearly-defined boundary line. At the same part was incomplete dulness, with similar lack of distinct definition. Pressure symptoms were entirely confined to the right bronchus, that side of the chest being almost immobile, and but very little air entering the right lung, while the left side was hyper-resonant, the respiration puerile. Great sense of oppression and some sharp pain was referred to about the locality of the right nipple: there was no perceptible or sphygmographic difference between the two radial pulses.

Dr. Green handed the case over to my care on the 14*th February*. By this time the right chest was quite immobile, only a doubtful sound of air entering the larger bronchi in the upper part of the lung could be heard. The left chest laboured hard at respiration, the lung was more markedly emphysematous. The man, if left alone to face these increasing troubles, had evidently but a short time to live.

15*th.*—I tied the right carotid and subclavian (third part) artery with the flat ligature.

The man recovered easily from the immediate effects of the operation. The right arm remained cold for six hours.

16*th.*—Nausea and some vomiting disturbed the man a good deal during the night.

17*th.*—After the sickness had passed off the man was very comfortable, and said he had very little of the pain and oppression which had previously distressed him.

March 20*th.*—Has made continuous progress—good sleep, good appetite, no sense of oppression of breathing. Yet, though entrance of air seems quite unobstructed, there is but little vesicular murmur; probably the lung, having been considerably injured by the previous obstruction, has not yet recovered, but it is getting freer.

April 2*nd.*—I found the patient playing draughts with another man, the board on a box at the right of his bed. He kept, according to order, his right arm pretty still, but at every move threw himself quite over in order to take the piece in his left hand. This accidental discovery accounted perhaps for some pulsation I had observed of late on the left side of the sternum, but probably it is more owing to an inherent weakness of the aorta, which would not permit it to withstand the current increased in the parts beyond by tying its two first large derivations.

May 12*th*.—He has improved, yet on damp, cold days suffers from pressure symptoms, but now referable to the left side, though the aneurism for which I tied the vessels has been, judging from symptoms, cured; yet the aorta beyond is evidently becoming dilated, but slowly and without marked symptoms.

June 2*nd*.—He left the hospital in fairly good condition.

It would answer no good purpose to follow out the rest of this patient's history; he spent nearly a year alternately in and out of hospital. Tumor symptoms on the left side of the chest slowly increasing. He died early in May, 1880.

At a future date something further on this case must be said; at present I can only remark that the occurrences subsequent to the beginning of April (1879), were all symptomatic of a fresh or new aortic dilatation, not of extension of the old one. The effect upon the aneurism, for which I operated, was as much as could be hoped for. The man, doomed in February, 1878, to a speedy and painful death, was rescued, his painful symptoms were subdued, he was for a certain period quite well, and might have lived long, but his vessels, especially his aorta, were so enfeebled, as to be excessively prone to the formation of aneurisms, and a new development of the same disease destroyed him. Freedom from distress and about eighteen months of life,

therefore, had been gained. It seems certain that had his vascular system, especially the parts of the aorta beyond the innominate, been somewhat sounder he might have continued to live a careful, but healthy life to the usual term. Such fresh formation of aneurism is not uncommon. Arterial disease giving rise to the condition in one place may also exist and have the same consequence elsewhere; for instance, the man whom Mr. Bellamy cured of a popliteal, has returned to care with a high abdominal aneurism, but nevertheless, as in the case of John S., the subsequent occurrence of disease in another part in nowise negatives the success of the operation.

The principles which I have endeavoured to elucidate have been thus far vindicated. Probably the experience of any one man, large as mine has been, can hardly ever be sufficient to prove to demonstration every point of this subject.[1] Much

[1] The other case of double distal deligation of carotid and sublelavian given in my table (p. 13) was performed by Dr. Lediard at the Cleveland Street Infirmary; that gentleman was good enough to allow me to be present. A few minutes of examination previous to operation led me to think the aorta too extensively affected to place the case among those whose characteristics have been given (p. 103), but the wisdom of the procedure was shown by marked and considerable improvement. Dr. Lediard will, I believe, publish the case; hence its details, even were they known to me, cannot be given here.

that has been written travels somewhat out of the usual track of surgery, but for every symptom or combination of symptoms recorded, I have clinical and often pathological warranty. Otherwise, I as a surgeon should hardly have felt justified in giving publicity to the more distinctly medical portions of the text. My aim will be secured if more attention be directed to this subject, if the safety of deligation with the flat ligature render salutary some operations hitherto invariably fatal, and if the lines I have endeavoured to trace be found such sure guides as will enable surgeons to combat with success so formidable a disease as aneurism at the root of the neck or within the thorax.

THE END.

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